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ABSTRACT

This document is one of three made up of newsletters from the School Mathematics Study Group's (SMSG) series of newsletters written between 1959 and 1972. This set contains newsletters 7, 8, 9, 14, 16, 18, 20, 21, 22, 26, 27, 29, 31, 32, 34, 37, 40, and 41, each devoted to describing SMSG publications; and newsletters 17 and 23, listing books for supplementary and enrichment use in mathematics. Related documents are SE 017 485 and SE 017 486. (JP)

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# SCHOOL
# MATHEMATICS
# STUDY GROUP

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## Newsletter No. 7

*April 1961*

*An Announcement*
*from*
*Yale University Press*

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## AN ANNOUNCEMENT

The NEW MATHEMATICAL LIBRARY series is now in production and the first six titles will be available in June. These are single-topic books intended as supplementary reading material for high school students, teachers, and the general educated lay public. More books are in manuscript stage and eventually it is intended that the NEW MATHEMATICAL LIBRARY will consist of more than 30 books. The availability of succeeding titles will be announced in later issues of this NEWSLETTER.

## OBJECTIVES

The objective of the School Mathematics Study Group is the improvement of the teaching of mathematics in the schools. School programs must attract and train more of those students who are capable of studying mathematics with profit. At the same time it must be recognized that for the interested student and layman there have been few real mathematics books available falling between the elementary textbooks used in schools and the advanced treatises which mathematicians usually write for each other.

THE BOOKS OF THE NEW MATHEMATICAL LIBRARY are an attempt by members of the mathematical community to fill this gap. The NML is under the auspices of an editorial Panel, Panel on Monographs, appointed by the Advisory Committee of SMSG.

The aim of the Library is to provide a series of short expository monographs on various mathematical subjects. The primary objectives of such monographs are: to disseminate good mathematics at the secondary school level which will supplement the usual high school curriculum; to awaken interest among gifted students; and to present mathematics as a satisfying, meaningful human activity. They are not intended as texts, but rather as reading material for students, their teachers, and the general educated lay public.

The monographs are written by outstanding mathematicians. In order to be sure that they are understandable and enjoyable by the audience for whom they are intended, preliminary versions are read by high school students and experienced high school teachers. Their comments, criticisms, and suggestions are passed on to the authors to form a basis for revision, if necessary.

## SPECIAL NOTE FOR TEACHERS

It is hoped that these books will be valuable *supplementary* material both for arousing interest in mathematics among high school students and for satisfying and deepening an already existing interest.

Some of these volumes will need but little background for understanding; others will demand more. These books will cover a wide variety of topics drawn from classical and modern mathematics.

Most of the books are so written that the beginning is easily understood by most high school students who have the *preparation indicated in the descriptions* of these books, but the later chapters, while not requiring any specific previous preparation, are often quite advanced and "tough going" in the sense that they demand more concentration and often more sophistication and intellectual maturity on the part of the reader. Therefore students should be told not to become discouraged if they have difficulty in following the exposition in the more advanced material. Many students will profit immeasurably by simply reading the early sections of the books.

The teacher should encourage the student to try the book again when mathematical skills have increased and mathematical maturity has been built up.

The reader should be warned that such books cannot be read as one reads a novel, but that one must make a strong intellectual effort. Neither do the books of the NML lend themselves to blanket assignments to entire classes. On the other hand the NML series represents such diverse topics, points of view, styles of exposition and levels of difficulty that readers of varying tastes and talents will profit by studying some of the books, even if they cannot come to grips with all of them.

## FORMAT

The NML series consists of 6″ x 9″ books with full color illustrations on their soft covers. The first six contain an average of about 145 pages; simple illustrations supplement the text. In addition to a short introduction by the author on the purpose of the content, each book (except problem collections) also includes a "Note to the Reader" by the editors where some advice is given to students. This should prove valuable especially to those who will read NML books without the benefit of help from a teacher.

## DISTRIBUTION

The trade editions NEW MATHEMATICAL LIBRARY are being published for the regular book trade by Random House, Inc. SMSG is making these monographs available to *secondary school students* and *teachers* at a reduced price of 95c each by agreement with Random House. When ordering please indicate the name and address of the school using the books.

An order blank is provided at the end of this NEWSLETTER for ordering the first six books directly from the School Mathematics Study Group. Shipment will be made as soon as the printing is completed in June.

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# DESCRIPTION OF THE NEW MATHEMATICAL LIBRARY

## *Numbers—Rational and Irrational*

by IVAN NIVEN

It is undoubtedly appropriate that the first book in this series is an examination of the oldest, the most familiar, and one of the most fundamental and important concepts of mathematics, that of number. Beginning with the integers, Professor Niven next considers in some detail the extensions of the number idea to rational and then to real numbers.

Irrational numbers are studied from geometric and analytic points of view. For example Section 3.7 is a natural supplement to a topic treated in every plane geometry course. Other geometric considerations include sketches of proofs of the impossibility of solving, with straight-edge and compass, the famous three construction problems of antiquity: squaring the circle, trisecting an angle, and doubling the cube. This topic is covered in Chapter 5 and would make excellent material for presentation in mathematics clubs.

Arithmetic properties of irrational numbers (e.g., that they have unending non-repeating decimal expansions) are also treated and can be made accessible even to good pre-algebra students.

The material in Chapter 6 is quite difficult and not so readily associated with classroom work. It treats approximations of irrational numbers by rational numbers and will probably be hard for people not used to inequalities.

Chapter 7 and some of the Appendices, on the other hand, contain many fascinating topics that can be used either in special classes, or for special students in ordinary classes, or in extra-curricular mathematical activities.

## *What Is Calculus About?*

by W. W. Sawyer

Deliberately designed to explain some of the fundamental ideas of the calculus to a student who has had only the beginnings of algebra, this book is a brilliant example of how important and seemingly complicated concepts of mathematics can be introduced to a student quite early in his development.

With a disarmingly simple and clever analysis of the intuitive ideas of speed of a particle and steepness of a graph, Professor Sawyer has succeeded in getting his reader to acquire an understanding of, and an ability to use, the calculus in solving many interesting problems. These include some simple applications to maxima and minima and to curve tracing.

The last chapters pose many more questions than they answer, but they point the way to further development, not only toward new types of problems such as those involving area and volume but also toward realization of the necessity of moving from the intuitive approach of this book to the more careful and logical approach of a more advanced text.

This book is not "Calculus Made Easy" but it is "A Simple Approach to the Calculus" for anyone who wants an introduction to the ideas and methods of this powerful branch of mathematics.

## *An Introduction To Inequalities*

by Edwin Beckenbach and Richard Bellman

This is the first of two books on inequalities in the Library and will give a student not only insight into the value and usefulness of inequalities but also an appreciation of the creative and genuinely artistic way a mathematician builds an elegant structure on a foundation of a few axioms, or generalizes a simple principle, or specializes and applies a powerful method.

The early introduction of some work on inequalities in elementary algebra now common in many schools should provide a good background but is not absolutely necessary for reading this book. Also the axiomatic approach in the first three chapters will be better appreciated by those who have already been exposed to this method of deduction. The authors lay particular emphasis on the derivation and use of algebraic inequalities but they illustrate and apply their results also in connection with problems in geometry and physics.

In the first three chapters the axiomatic foundation is laid; then the principal inequalities of analysis are developed and applied to the solution of several maximization and minimization problems usually reserved for the calculus. Finally the concept of distance is studied first in familiar Euclidean geometry and then as extended in several non-Euclidean geometries.

Writing with clarity, humor and style, the authors have produced a book which should appeal to many students in the upper grades of high school, introduce them to a topic often neglected in secondary schools, and develop in them a surprising degree of mathematical sophistication. Many problems are proposed with hints and solutions provided at the end to make the book ideal for independent study.

*Geometric Inequalities*

by Nicholas D. Kazarinoff

Here is a book that emphasizes geometric aspects of inequalities in contrast to the volume by Beckenbach and Bellman which deals mostly with the inequalities of analysis.

After the necessary algebraic tools are established, the first chapter states and proves the famous inequality of arithmetic and geometric means. The reader may find it interesting to compare this proof with the various proofs given by Beckenbach and Bellman for the same inequality. After the first chapter, Kazarinoff deals almost exclusively with geometric questions. The whole book is centered around the Isoperimetric Theorem which states that the plane figure of maximum area bounded by a curve of fixed length is the circle. But on the way, simpler geometric maximum and minimum problems involving triangles and other polygons are treated. Many beautiful theorems of geometry are stated, and frequently two or even three different proofs for one theorem are supplied. Some powerful mathematical concepts such as, for example, the Reflection Principle, and the idea that, in some specified set, figures with maximum area need not necessarily exist are made clear.

Parts of this book will be easily understood by a student well versed in elementary geometry but most of the time he will have to dig hard to mine the jewels available. Many theorems and problems of elementary geometry usually considered quite difficult turn out to be disarmingly simple under the keen analysis of a master. Many problems are posed for the reader, some with proofs supplied in the last chapter, some with hints, and even some for which as yet no solutions are known. Numerous figures help to make the geometric situations clear. Readers who delight in geometric reasoning will find themselves spending many fascinating hours working their way through these pages, and they will acquire a rich and varied experience in doing mathematics.

## *The Contest Problem Book*

### *Problems from the Annual High School Contests of the Mathematical Association of America*

The NML plans to publish a problem book at least once a year not only because problem solving is an ancient and honorable avocation of interested amateurs as well as of professional mathematicians, but also because the best way of learning mathematics is to "do" mathematics, and a good way for a beginner to do mathematics is to solve problems. The solution of nonroutine problems can stimulate interest and give incentive for the study of structure and logic in mathematics.

This is the first in a series of problem books in the New Mathematical Library and, it is hoped, will provide a rich source of material to which a teacher can refer an eager student. All problems in the MAA High School Contests during the last ten years have been compiled in this book, in chronological order; however, a classified index is provided so that those who are interested in particular types of problems will find them readily accessible. Arithmetic as well as geometric and algebraic problems are found in this collection.

An answer key is included as well as the complete solutions to all problems so that after a reader has solved one, he may see how others have done it.

Many problems here are easy for high school freshmen, many will be tough for seniors. Everybody can find something to his taste. Math clubs will find many of these problems good starting points for stimulating discussions.

## *The Lore of Large Numbers*

by PHILIP J. DAVIS

Today's world is full of numbers; housewives, secretaries, clerks, lawyers, scientists, businessmen, buyers and sellers, all use numbers daily. But what are numbers? What are their names? How and why are they so useful? What are some of their interesting properties? Are there different kinds of numbers and if so what distinguishes some from others? These are some of the questions that Dr. Davis asks and answers in this book.

In the author's own words: "It is a book to grow into and then to grow out of." It starts with the simplest questions on number that an inquisitive child raises, gradually increases a reader's knowledge, stimulates his imagination, and deepens his comprehension of the fundamental building blocks of mathematics.

Part I should be fascinating material for any junior high school student. He will get a feeling for large (and small) numbers: where they occur in natural phenomena; how they are named; how they are used; and how they may grow. A look at estimation and approximation in computation shows him how to handle very large (or very small) numbers efficiently as friends instead of having to struggle with them as enemies.

In Part II, Dr. Davis studies numbers at work in mathematics and science. The material is somewhat more involved than that in Part I, but most of it will be easily comprehended by any reader with a knowledge of elementary algebra and geometry. The story of the number $\pi$, the ratio of the circumference of a circle to its diameter, is one of the threads that ties together this section. Solutions of $n$ linear equations in $n$ unknowns, problems in residues, sequences and their rates of growth, are examples of some of the ideas considered in this final section.

The appendices collect and list not only many of the numbers used in science and engineering, but other interesting magnitudes such as the height, at the shoulder, of an African elephant and other magnitudes not usually listed elsewhere.

Many problems, from extremely simple ones up to and including some not yet solved by anyone, provide ample material on which readers may try their hand. They should be a gold mine for math club projects.

If you are not now on our mailing list but wish to receive further issues of this NEWSLETTER, please request, by means of a post card, that your name be added to the mailing list.

## AN IMPORTANT ANNOUNCEMENT

The School Mathematics Study Group is pleased to announce that Yale University Press, in addition to its regular publishing program, will now handle a major portion of the printing and distribution operations of the School Mathematics Study Group. The publication and distribution of the texts and teacher's commentaries for Junior and Senior High School Mathematics have now been taken over by the Press, effective July 1, 1961. *The volumes described in this* Newsletter *will be available only through Yale University Press, and orders will no longer be handled for these books by the SMSG office.*

Schools are urged to order their books promptly. *An order deadline has been set for June 15, 1961, and orders received after this date cannot be guaranteed for delivery in time for Labor Day.*

Books listed on the order form and described in the following pages are the only SMSG books which will be available through the Yale University Press during the academic year, 1961–62. In ordering books please use the order form contained in this Newsletter or specify the exact title in full when ordering.

All correspondence concerning orders for the texts and commentaries for grades 7–12 should be addressed to Yale University Press.

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## FORMAT

A slightly different format has been chosen for the volumes which Yale University Press will now distribute. The texts and commentaries, formerly issued in three parts, will now be issued in two parts, with the exception of the 12th grade. The 12th grade books will be issued in one part each. The texts and teacher's commentaries will be slightly reduced in size, from the original 8½ x 11 to 7 x 10 inches. Covers for the books will again be chosen for stiffness and durability, with different colors to distinguish the grades.

## PRICES

Both parts of a text or teacher's commentary will be sold as a set for $3.00 per set, with the exception of the two 12th grade books, which will be sold for $2.00 per copy. Replacement copies for each part may be ordered for $2.00 each. For a listing of the specific prices for each set please refer to the order form at the back of this NEWSLETTER. A discount of 20% will be given to accredited schools and a discount of 10% will be given to accredited libraries and individuals.

## BILLING PROCEDURE

Schools will be billed when the books are shipped. Yale University Press will be able to ship both parts of each text and commentary at the same time.

## DELIVERY DATES

Schools may expect their orders to be filled between August 15 and September 1.

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## AVAILABLE PUBLICATIONS:

The following SMSG publications will be available only through the Yale University Press effective July 1, 1961. Orders must be received by June 15, 1961, to insure delivery of the books in time for Labor Day.

### MATHEMATICS FOR JUNIOR HIGH SCHOOL (Grades 7 and 8).

(7) Volume 1, Part I
    Volume 1, Part II
        Commentary for Teachers, Part I
        Commentary for Teachers, Part II
(8) Volume 2, Part I
    Volume 2, Part II
        Commentary for Teachers, Part I
        Commentary for Teachers, Part II

### MATHEMATICS FOR HIGH SCHOOL (Grades 9–12).

(9) First Course in Algebra, Part I
    First Course in Algebra, Part II
        Commentary for Teachers, Part I
        Commentary for Teachers, Part II
(10) Geometry, Part I
    Geometry, Part II
        Commentary for Teachers, Part I
        Commentary for Teachers, Part II
(11) Intermediate Mathematics, Part I
    Intermediate Mathematics, Part II
        Commentary for Teachers, Part I
        Commentary for Teachers, Part II
(12) Elementary Functions
        Commentary for Teachers
(12) Introduction to Matrix Algebra
        Commentary for Teachers

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## DESCRIPTIONS OF PUBLICATIONS:

A description of the SMSG publications which Yale University Press will now handle follows here. This information has been drawn from the SMSG NEWSLETTER No. 6.

## MATHEMATICS FOR JUNIOR HIGH SCHOOL

### VOLUME 1—7TH GRADE (revised edition)

### AND

### VOLUME 2—8TH GRADE (revised edition)

Traditional mathematics courses for grades 7 and 8 include a review of the operations with whole numbers, fractions, and decimals. Percent is introduced, usually in terms of the three cases of percents, each of which is treated separately after various manipulations with percents, including fractional and decimal equivalents of percents. The traditional courses also have rather extensive treatments of percent applications such as commission, simple interest, discount, and insurance. A study of measurement has had an important place, but again much of this is a review of work done in earlier grades and little or none of it new from a mathematical point of view.

While the new SMSG courses provide for review of the fundamentals of arithmetic, this review has been placed in a new setting with emphasis on number systems. Number systems are treated from an algebraic viewpoint not only to deepen the student's understanding of arithmetic but also to prepare him for the algebra which is to come. The work on fractions is introduced by defining a fraction as a numeral for the rational number $\frac{a}{b}$ such that $b(\frac{a}{b}) = a$, $b \neq 0$. The grade 8 text starts with an informal treatment of coördinates and equations, and includes a brief introductory chapter on probability. Some of the probability problems were written by biologists associated with the Biological Sciences Curriculum Study, and in a chapter on the lever an attempt has been made to use language consistent with that of the Physical Science Study Committee physics course. Percent applications have a place in the new courses, as do other social applications, for example through governmental statistics in the chapter on graphs and in probability.

The new courses give more than one-third of the time to geometry, which is a very considerable change in emphasis from the traditional. Geometric ideas are in-

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troduced, first of all, from a non-metric point of view and then, after a careful treatment of measurement, students are led gradually to a study of properties of triangles and other geometric figures, plane and solid, through an informal deductive approach. Although there is no attempt to give a system of postulates for the geometry, properties are identified on an intuitive or inductive basis and then these properties are used to draw conclusions about, or to prove, other properties. In the chapter on drawings and constructions, instruments in addition to the classical ones are introduced and the student is also provided with experience in sketching figures, especially three-dimensional figures. A grade 8 chapter on non-metric geometry which comes just before the study of the measurement of volumes and surface areas is, in its topological approach, one of the greatest innovations.

## VOLUME 1: CHAPTER HEADINGS

1. What is Mathematics?
2. Numeration
3. Whole Numbers
4. Non-Metric Geometry
5. Factoring and Primes
6. The Rational Number System
7. Measurement
8. Area, Volume, Weight, and Time
9. Ratios, Percents, and Decimals
10. Parallels, Parallelograms, Triangles, and Right Prisms
11. Circles
12. Mathematical Systems
13. Statistics and Graphs
14. Mathematics at Work in Science

## VOLUME 2: CHAPTER HEADINGS

1. Rational Numbers and Coördinates
2. Equations
3. Scientific Notation, Decimals, and the Metric System
4. Drawings and Constructions
5. Symmetry, Congruence and the Pythagorean Property
6. Real Numbers
7. Permutations and Selections
8. Probability
9. Similar Triangles and Variation

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10. Non-Metric Geometry
11. Volumes and Surface Areas
12. The Sphere
13. Relative Error

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## MATHEMATICS FOR HIGH SCHOOL

## FIRST COURSE IN ALGEBRA (revised edition)

The SMSG ninth grade course is based upon structure properties of the real number system. This development of algebra is interesting, meaningful, and mathematically sound. It helps bring out the nature of mathematics and strengthens the student's algebraic techniques by relating them to basic ideas. Definitions and properties are carefully formulated and there is some work with simple proofs. The reading material, which is an important part of the course, is designed to help the student discover ideas. The number line and the simpler language of sets are used to help express the ideas. Inequalities are treated along with equations.

As its title suggests, the SMSG ninth grade course covers essentially the same material as does a conventional first year algebra text. It teaches the student how to perform the fundamental operations with real numbers and with variables and how to do the usual algebraic manipulations, including factoring, powers and roots, and work with polynomials and fractional expressions. It shows how to solve equations up through quadratic equations in one variable and linear equations in two variables. Graphs of linear and quadratic functions are treated. There is much experience in solving word problems.

### CHAPTER HEADINGS

1. Sets and the Number Line
2. Numerals and Variables
3. Sentences and Properties of Operations
4. Open Sentences and English Phrases
5. The Real Numbers
6. Properties of Addition
7. Properties of Multiplication
8. Properties of Order
9. Subtraction and Division for Real Numbers
10. Factors and Exponents
11. Radicals
12. Polynomial and Rational Expressions
13. Truth Sets of Open Sentences

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14. Graphs of Open Sentences in Two Variables
15. Systems of Equations and Inequalities
16. Quadratic Polynomials
17. Functions

## GEOMETRY (revised edition)

The SMSG geometry text differs from conventional ones in content, postulational scheme, and manner of treatment.

1. No artificial distinction is made between plane and solid geometry, and a considerable amount of the latter is included. Also, an introduction to analytic plane geometry is provided.

2. The postulate system is a modification of Birkhoff's, and is complete. Real numbers are used freely throughout the text, both in the theory and in problems.

3. Accuracy in the statement and use of postulates, definitions, and theorems is emphasized.

On the other hand, the text is still basically a treatment of synthetic Euclidean geometry, covering the usual topics: congruence, similarity, parallelism and perpendicularity, area, circles, and construction with straight-edge and compass. There is a main sequence of proved theorems, some minor stated theorems with proofs left as exercises for the students, and a long list of "originals." The basic postulates, definitions, and theorems are motivated by appeal to intuition, and many practical and computational problems are given.

### CHAPTER HEADINGS

1. Common Sense and Organized Knowledge
2. Sets, Real Numbers and Lines
3. Lines, Planes and Separation
4. Angles and Triangles
5. Congruences
6. A Closer Look at Proof
7. Geometric Inequalities
8. Perpendicular Lines and Planes in Space
9. Parallel Lines in a Plane
10. Parallels in Space
11. Areas of Polygonal Regions
12. Similarity
13. Circles and Spheres
14. Characterization of Sets. Constructions
15. Areas of Circles and Sectors
16. Volumes of Solids
17. Plane Coördinate Geometry

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## INTERMEDIATE MATHEMATICS (revised edition)

The SMSG eleventh grade text differs from traditional texts in the following important ways:

1. The SMSG text makes much greater demands on the student's *ability to learn by reading carefully worded expositions.* The writers believe that the development of this ability is essential for success in college mathematics.
2. The study of *number systems* is stressed as the basis for all understanding of both elementary and advanced mathematics.
3. The idea that algebra is a *logical structure* built on a relatively small number of fundamental principles is emphasized throughout the text.
4. Presentations which lead the student to make certain pre-determined *"discoveries"* are used where appropriate.
5. *Proof* is emphasized throughout in order that the student may gain some idea of the nature of a valid mathematical argument.
6. The *function concept* is developed spirally throughout the text.
7. *Coördinate geometry* is introduced earlier than usual and is used as a tool in the development of subsequent sections, notably those on trigonometry.
8. The presentation of logarithms reflects contemporary usage which requires more understanding of logarithms and exponential functions and relatively less emphasis on logarithmic computations.
9. The treatment of trigonometry emphasizes identities, equations, and graphs of the trigonometric functions more than the computations required in the solution of triangles.
10. *Vectors* are developed as a mathematical system and are applied to the solution of a wide variety of problems.

The writers hope that through the studying of this text the student will acquire some ability to handle unforeseen and unforeseeable problems.

The SMSG eleventh grade text is similar to conventional texts in these respects.

1. The text begins with a review and extension of the basic skills of first year algebra. This review is included in the initial study of number systems.
2. The content is essentially the same as that found in

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conventional courses in trigonometry and college algebra.

3. Practical applications are given about the same amount of attention as in conventional texts. It was not possible to increase the number of applications appreciably without making unwarranted assumptions about the student's understanding of related fields.
4. The exposition makes use of many illustrative examples and drawings.
5. There is an abundant supply of exercises which have been carefully graded as to difficulty.

CHAPTER HEADINGS

1. Number Systems
2. An Introduction to Coördinate Geometry in the Plane
3. The Function Concept and the Linear Function
4. Quadratic Functions and Quadratic Equations
5. Complex Number System
6. Equations of the First and Second Degree in Two Variables
7. Systems of Equations in Two Variables
8. Systems of First Degree Equations in Three Variables
9. Logarithms and Exponents
10. Introduction to Trigonometry
11. The System of Vectors
12. Polar Form of Complex Numbers
13. Sequences and Series
14. Permutations, Combinations, and the Binomial Theorem
15. Algebraic Structures

ELEMENTARY FUNCTIONS (revised edition)

The subject matter of *Elementary Functions* is basically conventional. It includes such topics from the theory of equations as the remainder and factor theorems and the usual methods for finding rational roots. The student will find the laws of exponents and logarithms and the rules for changing the base. The chapter on circular functions contains the familiar addition and subtraction formulas and their consequences, identities and equations, and inverse trigonometric functions. An appendix treats the solution of triangles. Emphasis is laid on graphs. However, each of these topics is treated with some novelty and in a new spirit.

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*Elementary Functions* applies the concept of mapping to polynomial, exponential, logarithmic, and circular functions. Effective use is made of the ideas of composition and inversion. The treatment of tangents is intuitive, elementary, and rigorous. It permits the introduction of Newton's method, and applications to maximum-minimum problems and to graphing. The treatment prepares for calculus without trespassing upon it. The explanation of exponentials and logarithms is novel and unusually clear and thorough. Trigonometry is freshly developed in line with the mapping idea. The style is informal. Explanations are full and concrete, and they convey the spirit of mathematical thinking.

CHAPTER HEADINGS

1. Functions
2. Polynomial Functions
3. Tangents to Graphs of Polynomial Functions
4. Exponential and Logarithmic Functions
5. Circular Functions

### INTRODUCTION TO MATRIX ALGEBRA (revised edition)

This text is designed for the last half of the 12th grade. It is devoted to a study of matrices, including applications to solutions of systems of linear equations and to geometry. At the same time careful attention is devoted to algebraic structure, but not to the point where a barren presentation results. Mathematics is introduced which is new to the student and the structure is developed as the text proceeds. It is the intent of the text to put the student close to the frontiers of mathematics and to provide striking examples of patterns that arise in the most varied circumstances. It provides an effective language and some dynamic concepts that will prove useful in many college courses. A special set of "Research Exercises" is appended in the hope that some students may be introduced to real mathematical research.

CHAPTER HEADINGS

1. Matrix Operations
2. The Algebra of 2 × 2 Matrices
3. Matrices and Linear Systems
4. Representation of Column Matrices as Geometric Vectors
5. Transformations of the Plane

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# Newsletter No. 8

*May 1961*

*An Announcement of The New Mathematical Library*

1

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| Geometric Inequalities (NML–4) | ...... | copies at $ .95 | $...... |
| The Contest Problem Book (NML–5) | ...... | copies at $ .95 | $...... |
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# Newsletter No. 9

*June 1961*

*Summary of Information*
*Concerning SMSG Publications*

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## RECENT SMSG NEWSLETTERS

During the past academic year, 1960–61, SMSG has published a variety of NEWSLETTERS. The basic purpose of these publications has been to acquaint the mathematics community with the latest activities and available publications of SMSG.

The following is a brief résumé of the SMSG NEWSLETTERS which have been published during the 1960–61 academic year.

NEWSLETTER No. 5, November 1960, is a digest of the experience with in-service preparation of mathematics teachers in SMSG experimental centers during the academic year 1959–60.

NEWSLETTER No. 6, March 1961, is a progress report of the activities of SMSG up to March 1961. This publication contains a history, a discussion of objectives and organization of SMSG, and a description of the various projects, general information on uses of SMSG texts, and a description of the contents of the available publications.

NEWSLETTER No. 7, April 1961 is an announcement concerning the *Yale University Press's* assumption of the publication and distribution of the *texts* and *teacher's commentaries* for Junior and Senior High School Mathematics, effective July 1, 1961.

NEWSLETTER No. 8, May 1961 is an announcement of the availability *to secondary school students and teachers* of the first six titles NEW MATHEMATICAL LIBRARY.

The NEWSLETTERS listed above, No. 5, 6, 7, and/or 8, are available from SMSG upon individual request.

## NEWSLETTER No. 9.

The purpose of SMSG NEWSLETTER No. 9 is to differentiate in detail those SMSG publications which should be ORDERED from the *Yale University Press* as contrasted with the books available from the *School Mathematics Study Group*.

## TEXTS AND TEACHER'S COMMENTARIES FOR JUNIOR AND SENIOR HIGH SCHOOL MATHEMATICS

The *Yale University Press,* in addition to its regular publishing program, will handle the publication and distribution of the texts and teacher's commentaries for Junior and Senior High School Mathematics, *effective* July 1, 1961.

The following SMSG publications will be available only through the Yale University Press effective July 1, 1961. Orders must be received by June 15, 1961, to insure delivery of the books in time for Labor Day.

### MATHEMATICS FOR JUNIOR HIGH SCHOOL (Grades 7 and 8).

(7) Volume 1, Part I
    Volume 1, Part II
        Teacher's Commentary, Part I
        Teacher's Commentary, Part II
(8) Volume 2, Part I
    Volume 2, Part II
        Teacher's Commentary, Part I
        Teacher's Commentary, Part II

### MATHEMATICS FOR HIGH SCHOOL (Grades 9–12).

(9) First Course in Algebra, Part I
    First Course in Algebra, Part II
        Teacher's Commentary, Part I
        Teacher's Commentary, Part II
(10) Geometry, Part I
    Geometry, Part II
        Teacher's Commentary, Part I
        Teacher's Commentary, Part II
(11) Intermediate Mathematics, Part I
    Intermediate Mathematics, Part II
        Teacher's Commentary, Part I
        Teacher's Commentary, Part II
(12) Elementary Functions
        Teacher's Commentary
(12) Introduction to Matrix Algebra
        Teacher's Commentary

Descriptions of the above publications are found in SMSG Newsletter No. 7. Order forms for the above books and/or individual copies of SMSG Newsletter No. 7 can be obtained from:

Yale University Press
*School Mathematics Study Group*
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New Haven, Connecticut

In ordering texts and teachers' commentaries for Junior and Senior High School Mathematics the order form at the end of this booklet may be used.

## PUBLICATIONS AVAILABLE ONLY FROM SMSG

The books listed on the enclosed order form and described in pages 6 through 11 are the only current books available after July 1, 1961 from SMSG. Special announcements will be made of additions to this list. Available books include STUDIES IN MATHEMATICS, SUPPLEMENTARY UNITS, CONFERENCE REPORTS, MATHEMATICS FOR THE ELEMENTARY SCHOOL, and the first six titles in the NEW MATHEMATICAL LIBRARY series.

In ordering these particular books please use the order blank enclosed in this Newsletter or specify the exact title in full when ordering.

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### STUDIES IN MATHEMATICS

### VOLUME 1. SOME BASIC MATHEMATICAL CONCEPTS

by R. D. LUCE

An exposition of elementary set theory, together with illustrations of the use of set concepts in various parts of mathematics.

Price: $1.00

### VOLUME 2. EUCLIDEAN GEOMETRY BASED ON RULER AND PROTRACTOR AXIOMS (revised edition)

by C. W. CURTIS, P. H. DAUS, and R. J. WALKER

A study, written for high school teachers, of the approach to Euclidean Geometry used in the SMSG tenth-grade textbook.

Price: $1.00

### VOLUME 3. STRUCTURE OF ELEMENTARY ALGEBRA

by VINCENT H. HAAG

An explanation of the approach to algebra found in the SMSG text "First Course in Algebra" emphasizing the foundations of the subject and the structural properties of elementary algebraic systems.

Price: $1.00

### VOLUME 4. GEOMETRY

by B. V. KUTUZOV

A translation of a Russian text for teachers. Longer than other volumes in this series (576 pages), it will probably be used mostly as a source of supplementary material.

Price: $5.00

## VOLUME 5. CONCEPTS OF INFORMAL GEOMETRY

by RICHARD D. ANDERSON

A study of basic ideas, concepts, and points-of-view of geometry, intended primarily for junior high school teachers.

Price: $1.00

## SUPPLEMENTARY MATERIALS

## MATHEMATICS FOR THE JUNIOR HIGH SCHOOL SUPPLEMENTARY UNITS (revised edition)

### CHAPTER HEADINGS

1. Sets
2. Special Figures in Projective Geometry
3. Repeating Decimals and Tests for Divisibility
4. Open and Closed Paths
5. Finite Differences
6. Recent Information on Primes
7. Games

| | | |
|---|---|---|
| Prices: | Mathematics for Junior High School Supplementary Units. Student | $ .75 |
| | Mathematics for Junior High School Supplementary Units. Commentary | $ .75 |

## ESSAYS IN NUMBER THEORY

These supplements were written for students who are especially good in mathematics and who have a lively interest in the subject. The author's aim in (1) and (2) is to lead the reader to discover for himself some interesting results and to experience the thrill of mathematical discovery. The others are more expository in nature, but they contain exercises to clarify the material and to give the reader a chance to work with the concepts which are introduced.

### VOLUME I: CHAPTER HEADINGS

1. Prime Numbers
2. Congruence
3. The Fundamental Theorem of Arithmetic

Price: $ .25

### VOLUME II: CHAPTER HEADINGS

1. Arithmetic Functions I
2. Arithmetic Functions II
3. Arithmetic Functions III
4. The Euclidean Algorithm and Linear Diophantine Equations
5. The Gaussian Integers
6. Fermat's Method of Infinite Descent
7. Approximation of Irrationals by Rationals
8. A New Field

Price: $ .50

## MATHEMATICS FOR HIGH SCHOOL
## INTERMEDIATE MATHEMATICS (PART I) SUPPLEMENTARY UNIT I

### (THE DEVELOPMENT OF THE REAL NUMBER SYSTEM) (revised edition)

This is a revision of Chapter I "The Real Number System," INTERMEDIATE MATHEMATICS (preliminary edition), Part I.

Price: $ .75

## CONFERENCE REPORTS

### REPORT OF A CONFERENCE ON ELEMENTARY SCHOOL MATHEMATICS

This publication includes abstracts and résumés of the presentation, discussions, and recommendations of a conference on elementary school mathematics held on February 13 and 14, 1959. The participants included college and university mathematicians, high school teachers, educational experts with special interest in arithmetic, supervisors, elementary school teachers, psychologists, and representatives of scientific and government organization having an interest in mathematics.

Price: $ .50

## REPORT OF AN ORIENTATION CONFERENCE FOR SMSG EXPERIMENTAL CENTERS

This publication includes abstracts of the presentations and discussions of a conference on mathematics for grades 7–12 held on September 19, 1959. The conference was called so that the teachers and consultants in the experimental centers for 1959–60 could discuss the aims, objectives, and content of the SMSG books for grades 7–12. The participants included a representative sampling of the text authors.

Price: $1.00

## REPORT OF AN ORIENTATION CONFERENCE FOR SMSG ELEMENTARY SCHOOL EXPERIMENTAL CENTERS

This publication includes abstracts of the presentations and discussions of a conference on elementary school mathematics held on September 23–24, 1960. The conference was called so that the teachers and consultants in the elementary school experimental centers for 1960–61 could discuss the aims, objectives, and content of the SMSG materials for grades 4, 5, and 6. These participants included a representative sampling of the text authors.

Price: $1.00

## MATHEMATICS FOR THE ELEMENTARY SCHOOL

The general nature of these materials is indicated in the unit headings below. Grade placement for the units listed is described in a preface to the volume in which *all* of these units have been collected. These materials are not yet ready for general classroom use and are being made available at this time to inform the mathematical community of the present state of the SMSG project on elementary mathematics. The two volumes, pupil's text and teacher's commentary, are available ONLY as a single unit. They cannot be purchased separately.

### UNIT HEADINGS

1. Concepts of Sets
2. Numeration
3. Nature and Properties of Addition and Subtraction

4. Techniques of Addition and Subtraction
5. Sets of Points
5M. Sets of Points
6. Recognition of Common Figures
7. Nature and Properties of Multiplication and Division
8. Techniques of Multiplication and Division
9. Developing the Concept of Fractional Numbers
10. Linear Measurement
11. Factors, Primes, and Common Denominators
12. Properties and Techniques of Addition and Subtraction of Fractional Numbers
13. Side and Angle Relationships of Triangle
14. Measurement of Angles
15. Extending Systems of Numeration
17. Area
19. Multiplication and Division of Fractional Numbers
21. Area of Rectangular Regions
24. Introducing Exponents

Price: $10.00

## NEW MATHEMATICAL LIBRARY

The NEW MATHEMATICAL LIBRARY is a series of short expository monographs on various mathematical subjects. The primary objectives of such monographs are: to disseminate good mathematics at the secondary school level which will supplement the usual high school curriculum; to awaken interest among gifted students; and to present mathematics as a satisfying, meaningful human activity. They are not intended as texts, but rather as supplementary reading material for students, their teachers, and the general educated lay public.

The first six titles are:

*Numbers: Rational and Irrational,* by IVAN NIVEN.

*What is Calculus About?,* by W. W. SAWYER.

*An Introduction to Inequalities,* by EDWIN BECKENBACH and RICHARD BELLMAN.

*Geometric Inequalities,* by NICHOLAS D. KAZARINOFF.

*The Contest Problem Book. Problems from the Annual High-School Contests of the Mathematical Association of America,* compiled by CHARLES T. SALKIND.

*The Lore of Large Numbers,* by PHILIP J. DAVIS.

School Price: $ .95 each

11/12

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ORDERS FOR TEXTS AND TEACHER'S COMMENTARIES FOR JUNIOR AND SENIOR HIGH SCHOOL MATHEMATICS MUST BE RECEIVED BY THE YALE UNIVERSITY PRESS BY JUNE 15, 1961, TO INSURE DELIVERY OF THE BOOKS IN TIME FOR LABOR DAY.

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| Development of the Real Number System | ...... | copies at $ .75 | $...... |

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|---|---|---|---|
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| Report of an Orientation Conference for SMSG Experimental Centers | ...... | copies at $1.00 | $...... |
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## MATHEMATICS FOR THE ELEMENTARY SCHOOL

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# Newsletter No. 14

*February 1963*

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SCHOOL MATHEMATICS STUDY GROUP
MONOGRAPH PROJECT

## OBJECTIVES AND ORGANIZATION

The aim of this project formed in 1958 and headquartered at New York University is to make available to high school students a number of short expository monographs on various mathematical subjects. Some of the objectives of this series of books, known as the *New Mathematical Library*, are: the dissemination of good mathematics in the form of elementary topics not usually covered in the curriculum; the awakening of interest among gifted students; the presentation of mathematics as a meaningful human activity.

The authors of the NML books are mathematicians interested and well versed in the fields they treat. The Editorial Panel consists of mathematicians and teachers concerned with the readability and understandability of NML books by high school students, even without the benefit of help from their teachers. Members of the Editorial Panel are appointed by the Director of SMSG and serve on the Panel for approximately three years.

## BOOKS PUBLISHED TO DATE

1. *Numbers: Rational and Irrational* by I. Niven
2. *What is Calculus About?* by W. W. Sawyer
3. *An Introduction to Inequalities* by E. Beckenbach and R. Bellman
4. *Geometric Inequalities* by N. D. Kazarinoff
5. *The Contest Problem Book: Problems from the Annual High School Contest of the Mathematical Association of America* compiled and with solutions supplied by C. T. Salkind
6. *The Lore of Large Numbers* by P. J. Davis
7. *Uses of Infinity* by L. Zippin
8. *Geometric Transformations* by I. M. Yaglom, translated from the Russian by A. Shields
9. *Continued Fractions* by C. D. Olds
10. *Graphs and Their Uses* by O. Ore

## BOOKS IN PREPARATION

NML 11 and 12, *The Hungarian Problem Books* based on the Eotvos Contests, 1894-1928, are expected to appear in the spring of 1963. Other books now in preparation treat topics from the early history of mathematics, group theory, geometry, number theory, topology, set theory and others.

## DISTRIBUTION

There is a trade edition published by Random House, Inc., a school edition distributed by the L. W. Singer Co. directly to elementary and secondary schools at a reduced rate, and library edition distributed by Library Publishers, Inc. The books are 6" x 9", average about 145 pages and have illustrations supplementing the text. The school and trade editions have soft covers while the library edition has hard covers.

For information on prices and ordering, see pp. 14 and 15.

## NOTE TO TEACHERS

The NML books are not textbooks. However, a mathematics teacher might use them in the following ways: If a student expresses interest in a topic touched on in class and more fully developed in one of the NML books, his teacher might tell him to study the relevant chapters in this book. If a large number of students express such an interest, a whole chapter from one of these books might be studied in class. Gifted students who seem to be ahead of their classmates could be told to work through one or another of the NML books independently.

It is difficult to say exactly what preparation is required on the part of a reader of a given NML book, but the following descriptions may serve as a guide. It should be kept in mind, however, that, even if little knowledge is necessary, quite a bit of mathematical maturity and sophistication may be needed in some instances.

It is important that students be aware of the nature of a mathematical book; i.e., that they do not expect to read it as they would read a novel, that they do not get discouraged if they get stuck, that they learn to come back to difficult points later in their careers.

The editors of NML have tried to publish books that start off in a relatively leisurely way and get progressively harder. Also, the books vary considerably not only in their contents, but in their manner of exposition, style and level of difficulty. It is hoped that readers of varying tastes and talents will profit by studying some of these books even if they cannot come to grips with all of them.

# DESCRIPTION OF THE NEW MATHEMATICAL LIBRARY

## NML 1

### NUMBERS — RATIONAL AND IRRATIONAL

by IVAN NIVEN

It is undoubtedly appropriate that the first book in this series is an examination of the oldest, the most familiar, and one of the most fundamental and important concepts of mathematics, that of number. Beginning with the integers, Professor Niven next considers in some detail the extensions of the number idea to rational and then to real numbers.

Irrational numbers are studied from geometric and analytic points of view. For example Section 3.7 is a natural supplement to a topic treated in every plane geometry course. Other geometric considerations include sketches of proofs of the impossibility of solving, with straight-edge and compass, the famous three construction problems of antiquity: square the circle, trisecting an angle, and doubling the cube. This topic is covered in Chapter 5 and would make excellent material for presentation in mathematics clubs.

Arithmetic properties of irrational numbers (e.g., that they have unending non-repeating decimal expansions) are also treated and can be made accessible even to good pre-algebra students.

The material in Chapter 6 is quite difficult and not so readily associated with classroom work. It treats approximations of irrational numbers by rational numbers and will probably be hard for people not used to inequalities.

Chapter 7 and some of the Appendices, on the other hand, contain many fascinating topics that can be used either in special classes, or for special students in ordinary classes, or in extra-curricular mathematical activities.

## NML 2

### WHAT IS CALCULUS ABOUT?

by W. W. SAWYER

Deliberately designed to explain some of the fundamental ideas of the calculus to a student who has had only the beginnings of algebra, this book is a brilliant example of how important and seemingly complicated concepts of mathematics can be introduced to a student quite early in his development.

With a disarmingly simple and clever analysis of the intuitive ideas of speed of a particle and steepness of a graph, Professor Sawyer has succeeded in getting his reader to acquire an understanding of, and an ability to use, the calculus in solving many interesting problems. These include simple applications to maxima and minima and to curve tracing.

The last chapters pose many more questions than they answer, but they point the way to further development, not only toward new types of problems such as those involving area and volume but also toward realization of the necessity of moving from the intuitive approach of this book to the more careful and logical approach of a more advanced text.

This book is not "Calculus Made Easy" but it is "A Simple Approach to the Calculus" for anyone who wants an introduction to the ideas and methods of this powerful branch of mathematics.

## NML 3

### AN INTRODUCTION TO INEQUALITIES

by EDWIN BECKENBACH AND RICHARD BELLMAN

This is the first of two books on inequalities in the Library and will give a student not only insight into the value and usefulness of inequalities but also an appreciation of the creative and genuinely artistic way a mathematician builds an elegant structure on a foundation of a few axioms, or generalizes a simple principle, or specializes and applies a powerful method.

The early introduction of some work on inequalities in elementary algebra now common in many schools should provide a good background but is not absolutely necessary for reading this book. Also the axiomatic approach in the first three chapters will be better appreciated by those who have already been exposed to this method of deduction. The authors lay particular emphasis on the derivation and use of algebraic inequalities but they illustrate and apply their results also in connection with problems in geometry and physics.

In the first three chapters the axiomatic foundation is laid; then the principal inequalities of analysis are developed and applied to the solution of several maximization and minimization problems usually reserved for the calculus. Finally the concept of distance is studied first in familiar Euclidean geometry and then as extended in several non-Euclidean geometries.

Writing with clarity, humor and style, the authors have produced a book which should appeal to many students in the upper grades of high school, introduce them to a topic often neglected in secondary schools, and develop in them a surprising degree of mathematical sophistication. Many problems are proposed with hints and solutions provided at the end to make the book ideal for independent study.

## NML 4

### GEOMETRIC INEQUALITIES

by NICHOLAS D. KAZARINOFF

Here is a book that emphasizes geometric aspects of inequalities in contrast to the volume by Beckenbach and Bellman which deals mostly with the inequalities of analysis.

After the necessary algebraic tools are established, the first chapter states and proves the famous inequality of arithmetic and geometric means. The reader may find it interesting to compare this proof with the various proofs given by Beckenbach and Bellman for the same inequality. After the first chapter, Kazarinoff deals almost exclusively with geometric questions. The whole book is centered around the Isoperimetric Theorem which states that the plane figure of maximum area bounded by a curve of fixed length is the circle. But on the way, simpler geometric maximum and minimum problems involving triangles and other polygons are treated. Many beautiful theorems of geometry are stated, and frequently two or even three different proofs for one theorem are supplied. Some powerful mathematical concepts such as, for example, the Reflection Principle, and the idea that, in some specified set, figures with maximum area need not necessarily exist are made clear.

Parts of this book will be easily understood by a student well versed in elementary geometry but most of the time he will have to dig hard to mine the jewels available. Many theorems and problems of elementary geometry usually considered quite difficult turn out to be disarmingly simple under the keen analysis of a master. Many problems are posed for the reader, some with proofs supplied in the last chapter, some with hints, and even some for which is yet no solutions are known. Numerous figures help to make the geometric situations clear. Readers who delight in geometric reasoning will find themselves spending many fascinating hours working their way through these pages, and they will acquire a rich and varied experience in doing mathematics.

## NML 5

### THE CONTEST PROBLEM BOOK

*Problems from the Annual High School Contests of the Mathematical Association of America*

The NML plans to publish a problem book at least once a year not only because problem solving is an ancient and honorable avocation of interested amateurs as well as of professional mathematicians, but also because the best way of learning mathematics is to "do" mathematics, and a good way for a beginner to do mathematics is to solve problems. The solution of non-routine problems can stimulate interest and give incentive for the study of structure and logic in mathematics.

This is the first in a series of problem books in the New Mathematical Library and, it is hoped, will provide a rich source of material to which a teacher can refer an eager student. All problems in the MAA High School Contests during the last ten years have been compiled in this book, in chronological order; however, a classified index is provided so that those who are interested in particular types of problems will find them readily accessible. Arithmetic as well as geometric and algebraic problems are found in this collection.

An answer key is included as well as the complete solutions to all problems so that after a reader has solved one, he may see how others have done it.

Many problems here are easy for high school freshmen, many will be tough for seniors. Everybody can find something to his taste. Math clubs will find many of these problems good starting points for stimulating discussions.

## NML 6

### THE LORE OF LARGE NUMBERS

by PHILIP J. DAVIS

Some of the questions that Dr. Davis asks and answers in this book are: How and why are numbers so useful? What are some of their interesting properties? Are there different kinds of numbers and if so what distinguishes some from others?

In the author's own words: "It is a book to grow into and then to grow out of." It starts with the simplest questions on number that an inquisitive child raises, gradually increases a reader's knowledge, stimulates his imagination, and deepens his comprehension of the fundamental building blocks of mathematics.

Part I should be fascinating material for any junior high school student. He will get a feeling for large (and small) numbers: where they occur in natural phenomena; how they are named; how they are used; and how they may grow. A look at estimation and approximation in computation shows him how to handle very large (or very small) numbers efficiently as friends instead of having to struggle with them as enemies.

In Part II, Dr. Davis studies numbers at work in mathematics and science. The material is somewhat more involved than that in Part I, but most of it will be easily comprehended by any reader with a knowledge of elementary algebra and geometry. The story of the number $\pi$, the ratio of the circumference of a circle to its diameter, is one of the threads that ties together this section. Solutions of n linear equations in n unknowns, problems in residues, sequences and their rates of growth, are examples of some of the ideas considered in this final section.

The appendices collect and list not only many of the numbers used in science and engineering, but other interesting magnitudes such as the height, at the shoulder, of an African elephant and other magnitudes not usually listed elsewhere.

Many problems, from extremely simple ones up to and including some not yet solved by anyone, provide ample material on which readers may try their hand. They should be a gold mine for math club projects.

**NML 7**

## USES OF INFINITY

by LEO ZIPPIN

The word "infinity" elicits feelings of awe and wonder, and the idea of the infinite has stirred man's imagination profoundly in all ages. But one who has not worked in the mathematical sciences is likely to doubt that infinity can be used, if to use something means to acquire some form of control over it. Professor Zippin's book demonstrates that the uses of infinity in precisely this sense occupy the mathematician; for, infinities of all types and magnitudes are his raw materials and processes involving infinity are among his most powerful tools.

This book is designed so as to make little demand upon the reader's technical competence in mathematics. It can be read with great profit by beginning high school students as well as by students who are ready for elementary calculus. On the other hand, inasmuch as it is a carefully reasoned presentation, with many interesting concrete examples, of somewhat abstract ideas, the reader must be prepared to work; he must be willing to think through these ideas for himself.

The early chapters are descriptive and intuitive, full of examples that illustrate infinite processes. The uses of infinity in mathematics are viewed as falling into four categories. An illustration of the first category would be a theorem of geometry dealing with a single representative object, say an isosceles triangle, of some infinite class, e.g. the class of all isosceles triangles. The second category comprises assertions, such as the binomial theorem, about an explicit infinity of cases, each involving a finite collection. Problems that can be treated by mathematical induction fall into this category. The third category includes a diversity of infinite processes associated with the concept of "limit"; and problems in the fourth category belong to abstract set theory.

With great charm and clarity, Professor Zippin discusses how infinity is handled in each of these cases. Recognizing that it is neither possible nor pedagogically desirable to say at once all of the key remarks needed to explain a mathematical idea, he raises many questions, answers them partially in various contexts throughout the book, and finally treats them with the precision necessary to give the reader an excellent grasp of the fundamental notions of infinity used in the calculus and in virtually all other mathematical disciplines. This style of presentation takes the best possible advantage of both the intuitive and the logical resources of the reader.

The challenging problems posed throughout the text are particularly well suited to lead the reader to a deeper understanding of the ideas discussed. Complete solutions to these problems are given at the end of the book.

## NML 8

### GEOMETRIC TRANSFORMATIONS

by I. M. YAGLOM

translated from the Russian by A. Shields

The title of Professor Yaglom's introduction to his book *Geometric Transformations* is "What Is Geometry?", and one of the questions he raises is: what, precisely, are "geometric properties" of figures? As a first approximation to a complete answer, Professor

Yaglom offers this definition: geometry is the study of those properties of figures that are not changed by motions of the figures.

This, of course, reminds us of the usual definition of congruence: two figures are congruent if, by a motion, they can be made to coincide. Thus we are naturally led to the study of such "motions", i.e. to the study of those transformations of the plane which leave distances between pairs of points unchanged.

The present NML volume is only the beginning of a larger work; it is part of Yaglom's book that deals exclusively with and lists all such motions (also called "isometries"): translation in a given direction by a given distance, rotation about a given point through a given angle, and reflection in a given line. The properties of each and the effects of all conceivable combinations of these motions is studied.

The text is brief, but there are many rather difficult problems designed to illustrate the assertions made in the text. The problems are solved in the second part of the book. The descriptive definition of "isometry" as distance preserving transformation, given in the beginning, is supplemented later by the constructive definition of "isometry" as either a translation, or a rotation, or a glide reflection.

Although the word "group" never occurs in this book, Professor Yaglom's approach to geometry is essentially group-theoretic and fundamental.

Students who have taken a traditional course in plane geometry will probably not find *Geometric Transformations* very difficult, but they will have to struggle hard in order to solve the problems, and may find, on occasion, that the style is somewhat different from that to which they have been accustomed. This is not surprising in an unorthodox treatment of a mathematical topic, especially in a translation where the conscientious translator has striven to remain as faithful as possible to the original version.

## NML 9

### CONTINUED FRACTIONS

by C. D. OLDS

Continued fractions were studied by the great mathematicians of the seventeenth and eighteenth centuries and are a subject of active investigation today. Fractions of this form provide much insight into many mathematical problems — particularly into the nature of numbers — and the theory of continued fractions is a powerful tool in number theory and in other mathematical disciplines.

Professor Olds' book is an easy-going discussion of simple continued fractions, stressing some of their elementary applications. A knowledge of high school algebra up to the study of quadratic equations should be sufficient background for a reader. However, some of the expressions look rather formidable and might frighten the novice.

The book begins with an imaginative account of how continued fractions might be discovered accidentally. Then several numerical examples lead gradually to a general discussion of the process of expanding rational fractions into simple finite continued fractions, and to a consideration of convergents and their properties. Also included in Chapter I is an interesting brief survey of the history of continued fractions, from their earliest traces in ancient arithmetical writings to their present day usefulness in the computer field.

The second chapter deals with one of the applications of continued fractions — the solution of linear Diophantine equations. Many fascinating riddles and mathematical games give rise to equations whose solutions must be integers; Professor Olds poses and solves some amusing and instructive examples of such problems.

Chapter 3 treats the expansion of irrational numbers into infinite continued fractions, and includes an introductory discussion of the idea of limits. Here one sees how continued fractions can be used to give better and better rational approximations to irrational numbers. These and later results are closely connected with and supplement similar ideas developed in Niven's book, *Numbers: Rational and Irrational.*

The periodic properties of continued fractions are discussed in Chapter 4. The reader will find this chapter more challenging than the others, but the end results are rewarding. The main part of the chapter develops a proof of Lagrange's theorem that the continued fraction expansion of every quadratic irrational is periodic after a certain stage.

The final chapter is intended to give the reader a look into the future. Here the famous theorem of Hurwitz is presented without proof as an example of the class of related theorems and problems on approximations. But, as Professor Olds points out, this field by no means exhausts the avenues of exploration open to the interested student; *Continued Fractions* can serve as the point of departure for further study of a variety of exciting topics.

NML 10

## GRAPHS AND THEIR USES

by OYSTEIN ORE

In this book Professor Ore shows how the theory of graphs may be employed for such diverse purposes as: Recording the games played by participating teams of a baseball league at every stage of the season; representing a biological breeding experiment; scheduling a chess tournament in the most efficient manner; determining the cheapest way of building a railroad net; illuminating the theory of mathematical relations; solving some ancient puzzles; analyzing winning (or losing) positions in certain games. As the reader studies these varied applications, he becomes increasingly interested in the properties of graphs for their own sake and for the purpose of applying graph methods to mathematical problems.

While virtually no mathematical background is required of the reader, the book leads him to some important concepts such as, for example, order relations and equivalence classes.

After presenting and proving Euler's formula for polyhedra, this little book culminates in a discussion of the famous Four Color Conjecture and actually proves that no more than five colors are needed to color any map of the globe in such a way that countries with common boundary curves have different colors.

NML 11, 12

## THE HUNGARIAN PROBLEM BOOKS

*based on the Eötvös Competitions, 1894-1905*

translated by E. Rapaport

The Eötvös Contests in elementary mathematics have been open to Hungarian students in their last year of high school ever since 1894. They are famous for the simplicity of the concepts employed, the mathematical depth reached, and the diversity of elementary mathematical fields touched. But perhaps their most remarkable feature is the influence that they, together with a mathematics journal for students, seem to have had on the young people of that small country. Among the winners of these contests many turned into scientists of international fame; e.g. L. Fejér, T. von Kármán, D. König, M. Riesz, G. Szegö, T. Radó and E. Teller.

The main prerequisite for profitable study of these problems is curiosity. Many of the simple problems on number theory are accessible to a high school freshman; the geometry problems can be tackled by the reader who has completed his plane geometry course, and in some cases, a knowledge of trigonometry will help; the algebra problems are of varying levels of difficulty. But all problems require ingenuity and inventiveness for successful solution.

The main purpose of this imaginative collection is to instruct the reader by having him study the solutions presented here, together with some of the more sophisticated material in the explanatory notes. He should not feel that he is being tested, but that he is being taught. Many of the problems open the door to a rather deep study of some fertile aspect of certain mathematical ideas.

This translation is based on the revised Hungarian edition of J. Kürschak's original compilation.

* * *

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# Newsletter No. 16

*October 1963*

# SMSG Publications

## CONTENTS

New Publications, 3

Order Forms

Sample Text Editions, 8

Other Publications, Vroman's, 11

New Mathematical Library, Singer, 13

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## APPLICATIONS OF MATHEMATICS

The applications of mathematics have been the subject of much discussion recently. This is, therefore, an auspicious time to announce two new volumes in the Studies in Mathematics series, both of which are devoted to this topic.

The first of these, Studies in Mathematics, Volume X, *Applied Mathematics in the High School,* is based on a series of lectures delivered by Professor Max M. Schiffer of Stanford University. These lectures were transcribed and were edited by Professor Leon Bowden of Victoria College, University of British Columbia.

Three chapters are devoted to applications appropriate to the SMSG curriculum with emphasis on the elementary algebra of the ninth grade and the geometry of the 10th grade. An appendix is devoted to applications of matrix algebra.

The second of these volumes, Studies in Mathematics, Volume XI, *Mathematical Methods in Science,* is based on a course of lectures delivered by Professor George Polya, Stanford University. These lectures were transcribed and edited also by Professor Leon Bowden.

The course points to the history of certain elementary parts of science as a source of efficient mathematics teaching in the classroom. Simple physical or pre-physical problems are introduced and the relation of mathematics to science and science to mathematics is discussed. Some use is made of elementary calculus.

## STUDY GUIDE IN CALCULUS

A booklet containing Study Guides in Algebra, Geometry, Number Theory, and Probability and Statistics was made available in the spring of 1963. A supplement to this booklet consisting of a Study Guide in Calculus has been prepared and is now automatically distributed with the above booklet. The main purpose of the Study Guide is to list and organize suitable references for study. Elementary, intermediate and advanced references are listed for each of the following basic topics: Properties of the Real Number System; Functions, Limits, Continuity, and Derivitive; Differentiation, the Differential and Applications; the Definite Integral; Integrability, and the Fundamental Theorem; Applications of Integration; Calculus of Circular, Logarithmic and Exponential Functions; Advanced Techniques of Integration; and Miscellaneous Topics (polar coordinates, arc length, sequences and series, history of calculus). An annotated bibliography is included.

## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

A series of 30 half-hour color films, entitled "A Brief Course in Mathematics for Elementary School Teachers", will be available for rental early this fall. As indicated in its title, the series is intended primarily for inservice elementary school teachers. It is *not* addressed solely to a particular program but, rather, is planned to furnish a foundation in mathematics for any one of a number of contemporary programs. The series is mathematical in content but no mathematical prerequisites are presumed. The content delineates the main strand of mathematical training for students from kindergarten through the sixth grade, the whole numbers, the rational numbers and an introduction to the real numbers. A second strand, that of geometry, is presented on an informal level and the connecting topic of measurement is also treated. Lecturer for the series is Professor Stewart Moredock of Sacramento State College.

The titles of the 30 lectures are:

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2 Whole Numbers
3 Names for Numbers
4 Numeration Systems
5 Place Value and Addition
6 Addition and Subtraction
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26 Solid Figures
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28 Measurement of Solids
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30 The Real Numbers

The first 16 of these films provide a suitable background in mathematics for teachers of grades K-3. The remainder, building on these, are concerned with the mathematics normally taught in grades 4-6.

The distributor for these films is Modern Learning Aids, 3 East 54th Street, New York 22, New York. Distribution will be from the following five locations:

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Inquiries may be addressed to any of the above addresses.

The rental cost will be $6.75 for a three school day period when 16 or more films are ordered at one time, and $7.00 per film per three-school-day period when less than 16 are ordered. The films may be ordered for longer periods. The rental for each additional five school days use will be that for the initial three school day's use.

Long-term leases can also be arranged for three year periods or more.

These films are not available for purchase. The advisory committee for these films is convinced that similar series will be produced from time to time and that when a superior series appears there will be no point in continuing this one in existence.

## FILM TEXT

A text to accompany the above series of films is also available. This text bears the same title as the film series and is Volume IX in the Studies in Mathematics series. Each film in the series has a corresponding chapter in the text which reviews and expands on the material in the lecture. An ample supply of exercises is provided.

While the text was designed to accompany and support the filmed course, it is also appropriate as a text for an inservice course for elementary school teachers.

## VERY SHORT COURSE IN MATHEMATICS FOR PARENTS

When students are placed in a new mathematics program, their parents are often curious about the reasons for the new program and the differences between that program and the one they went through when they were in school. Some parents find it hard to see why any change is needed. Others merely wish to have some information on the nature of the changes being made. In any case, many parents do have questions which rightfully deserve answers.

Some of these questions have already been answered in print. (See especially "The Revolution in School Mathematics", National Council of Teachers of Mathematics, 1201 - 16th Street, N. W., Washington 6, D. C.) There are, however, two kinds of questions often asked by parents which are not so easily answered. Typical of these are: "What are the new topics in the new programs and what good are they?" and "What are the new ways of treating traditional mathematical topics?"

These questions cannot be answered by means of generalities.

The only way for a parent to understand a new mathematical topic, or a new way of presenting an old one, is to study it just as his children do in school.

For this reason SMSG has prepared a small textbook for parents. Chapter 1 of this text deals with number bases other than 10, a topic relatively new to the school mathematics program. The other chapter deals with a review of the whole numbers in which emphasis is put on concepts and structure, as well as computation.

The book is meant to be used as a text and to be studied carefully, rather than read superficially. Exercises are provided throughout each chapter, answers to which are supplied at the end of the text.

**NOTE:** At the 1963 summer writing session preliminary versions of text materials were prepared in the following areas: student and teacher material for grades K-3, some junior high school units attempting to bring physical science and mathematics into closer contact, and a senior level one-semester course in analytic geometry.

As soon as the SMSG experimental classes have been supplied with these materials, additional copies for inspection, but not for classroom use, will be made available. Their availability will be announced in an issue of the SMSG NEWSLETTER.

No decision has yet been reached as to when inspection copies of the various versions of the programed algebra course will be made available for inspection. As soon as a decision has been reached this also will be announced in an SMSG NEWSLETTER.

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**SCHOOL**
**MATHEMATICS**
**STUDY GROUP**

# Newsletter No. 17

*March 1964*

PANEL ON
SUPPLEMENTARY PUBLICATIONS

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# CONTENTS

PLANS AND PROCEDURES OF THE PANEL, 5

PUBLICATIONS NOW AVAILABLE, 6

SELECTED LIST OF INEXPENSIVE BOOKS, 9

ORDER FORM, 47

# PLANS AND PROCEDURES OF THE PANEL

The Panel on Supplementary Publications believes that there is a need for a variety of small publications for secondary schools, with these two purposes: (a) to supplement the regular textbook with new topics or with new treatments of old topics, and (b) to provide enrichment material for students with special interests. The range of materials will be wide: in grade level, from 7 through 12; in difficulty, from simple and basic to difficult and sophisticated; in treatment, from self-teaching to classroom-oriented; and in interest, from general to specialized. Most exercises included in the booklets will have answers — sometimes in the same booklet, but usually in a separate booklet which also contains suggestions for teachers. Each booklet published is approved by the whole panel, although specific members of the panel take the responsibility for supervising and editing the separate publications.

Since many of the pamphlets are adapted from SMSG texts (see individual descriptions below), teachers who wish to try some of the new materials without adopting an entire SMSG text will find these booklets ideal.

The Panel on Supplementary Publications is constantly searching for new manuscripts and would be glad to hear from interested writers. Any topic, whether it be a familiar one with a fresh presentation or a new one that might appeal only to a relatively small number of students, will be considered if it is of interest to secondary school pupils. It is particularly appropriate to suggest applications of mathematics to areas where the pertinent non-mathematical background can be summarized quickly. Hopefully, many of the pamphlets, even though designed for students, will be useful to teachers to read by themselves, or to study in groups gathered together for in-service training.

Anyone who is interested should write to a member of the Panel listed below. A bulletin of information that outlines the procedure to be followed will then be sent. Briefly, there are five steps in the process:

(1) An outline of the pamphlet is submitted

(2) The outline is rejected or accepted (with the payment of a non-refundable advance of \$5.00 per page)

(3) The finished manuscript is evaluated by the panel

(4) A decision is made to accept the manuscript (in which case the rest of the fee, \$15.00 per page, is paid to the author); or to reject the manuscript (in which case it is returned to the author for his own future use)

(5) The pamphlet is published

(4)

## LIST OF MEMBERS OF THE PANEL

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Professor Augusta L. Schurrer, State College of Iowa, Cedar Falls, Iowa
Mr. Henry W. Syer, Kent School, Kent, Connecticut

## PUBLICATIONS NOW AVAILABLE

### SP-1. Functions

This pamphlet is essentially Chapter 1 and Section 9 of Chapter 4 of the SMSG text, *Elementary Functions*. A few minor changes have been made to clarify and to make the material self contained. Some background material on sets and a section on functions as sets of ordered pairs have been added.

It is intended for use as a unit in any course following a course in plane geometry and one-and-a-half or two years of algebra.

The material contained herein is basic to an understanding of the trigonometry of real numbers and the calculus as well as many other parts of mathematics. (41 pages)

### SP-2. Circular Functions

This pamphlet is essentially the major portion of Chapter 5 of the SMSG text, *Elementary Functions*. A few minor changes have been made for clarity and to make the material self contained.

It is intended for use as a supplement to a standard trigonometry text that emphasized the solution of triangles or as a unit in a course on elementary functions.

No previous knowledge of trigonometry is assumed but a background of a course in plane geometry and two years of algebra are prerequisites for the study of this material. In addition, it is assumed that the student is familiar with the concept of a function as presented, for example, in the SMSG pamphlet, *Functions*, or in the SMSG text, *Elementary Functions*. (49 pages)

**SP-3. Teacher's Commentary** for Functions and for Circular Functions

**SP-4. Complex Number System**

The pamphlet on the Complex Number System is essentially a reprint of Chapter 5 of the SMSG text *Intermediate Mathematics*. Depending upon the preparation and ability of the class, the pamphlet is suitable for use in grades 10-12. It presents the complex number system as an extension of the real number system and includes a discussion of the Argand plane and the n roots of an n-degree polynomial equation.

One of the great achievements of the human intellect, the complex number system, (and areas closely related to it) is being intensively cultivated at the present time and its application in the sciences and engineering grow daily. (52 pages)

**SP-5. Teacher's Commentary** for Complex Number System

**SP-6. System of Vectors**

This pamphlet is essentially a reprint of Chapter 11 of the SMSG text *Intermediate Mathematics*. The material is suitable for use by a class that has studied geometry. Vectors, identified as directed line segments, are introduced; equivalence, sum, and other necessary algebraic properties are defined or demonstrated; and several applications, particularly to geometry and physics, are shown. Finally, the notion of a vector space is presented.

A command of vectors is essential to anyone who aspires to a career in the physical sciences. Also, an understanding in other disciplines, such as geometry, is enhanced by a knowledge of vectors. And, vectors, by themselves, present a helpful example of a mathematical system whose elements are not real numbers. This pamphlet provides an opportunity for a teacher, student, or class to explore this area. (50 pages)

**SP-7. Teacher's Commentary** for System of Vectors

**SP-8. Non-Metric Geometry**

The pamphlet on Non-metric Geometry is essentially a reprint of Chapter 1 of the SMSG book, *Studies in Mathematics*, Vol. VII, "Intuitive Geometry."

The pamphlet, which is directed for use in grades 6-7, introduces the basic ideas of geometry independent of numbers.

It is important that students meet the vital concepts of point, line, plane, and space as early as possible in their study of mathematics. The booklet can be used to try out such ideas at the teacher's discretion. (39 pages)

### SP-9. Teacher's Commentary for Non-Metric Geometry

### SP-10. Plane Coordinate Geometry

The pamphlet on Plane Coordinate Geometry is essentially a reprint of material which has appeared earlier as Chapter 17 of the SMSG text *Geometry.* Topics that are discussed include straight lines, circles, distance between points, and intersections of lines. Analytic proofs of geometric theorems are demonstrated.

One of the curriculum changes widely recommended at the present time is a change in emphasis in the teaching of geometry. Hopefully, a coordinate plane and analytic proofs will be an integral part of any geometry course. The pamphlet, *Plane Coordinate Geometry,* may be used to introduce these notions into a course working with a standard high school geometry text. (61 pages)

### SP-11. Teacher's Commentary for Plane Coordinate Geometry

### SP-12. Inequalities

This pamphlet is an exploration of the order properties of real numbers under the operations of addition and multiplication. It begins with order on the number line and proceeds to simple and compound open sentences in one variable involving inequalities and the graphs of their truth sets. The comparison and transitive properties of order are developed in some detail, after which there is considerable material on the addition and multiplication properties of order. Several proofs are included in the text, and additional ones are to be found in the exercises for students. A chapter is devoted to polynomial inequalities and the solution sets of rational inequalities. The pamphlet concludes with a Chapter on the graphing of inequalities in two variables. (63 pages)

### SP-13. Teacher's Commentary for Inequalities

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## CHOOL MATHEMATICS STUDY GROUP
## ELECTED LIST OF
## NEXPENSIVE BOOKS FOR SUPPLEMENTARY
## SE IN MATHEMATICS

The present curriculum in mathematics is so flexible
at many teachers will wish to have extra books avail-
ble for individual pupils to read or for an entire class
use as supplementary texts. The Panel on Supple-
entary Publications of the School Mathematics Study
roup, in planning to sponsor such publications,
ought it wise first to survey what was already avail-
ble. Since these books will usually be bought from
hool budgets, this list of commercially published
ooks is limited to inexpensive ones, with the arbi-
ary definition that inexpensive means those which
etail for $1.00 or less. The list is complete insofar as
e can judge, but we are sorry if your favorite book
as been overlooked. Would you be so kind as to tell
about it for future use. The present list does not
nclude books beyond April 1, 1963, but it will be
rought up to date in future editions.

First, all books in the publication *Books in Print* un-
er the heading "Mathematics" or allied headings were
sted. Then, the panel decided whether each listed
ook should be included on the final bibliography or
ot. It must be remembered that the purpose was
*athematics* for *secondary* school *pupils*. Thus, mate-
ial was omitted if it pertained to pedagogy in mathe-
atics or mathematics at a level or with a treatment
f interest *only* to teachers.

The list has been annotated to make it easier for
ou to make a selection. The division of the bibliog-
aphy into six sections may help you find the book you
ant, but since some books may be useful in more
han one category, you should look over the complete
ist. Also, a list of addresses of publishers is included
t the end of the bibliography.

A symbol is used at the end of each annotation to
esignate as closely as possible the background re-
uired for that book, or the subject in which the book
ay be most useful. The following code is used:

Ar: Arithmetic
A-1: First-year Algebra
A-2: Second-year Algebra
A-3: Third-year Algebra
G: Euclidean Geometry
T: Trigonometry
C: Calculus

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*An attempt has also been made to indicate the diff culty of the books by using a code which runs from to 5, meaning easy to difficult, respectively. Althoug such a judgment is relative, and will also vary wit the interests of the pupils using the book, it is hope that such a classification will be of some use to fit th books to your needs.*

## ALGEBRA

ADLER, I.; **The New Mathematics;** NYC; Ne American Library; 1960; 187 pp.

This book includes a systematic, rigorous, but eas to follow review of the basic structure of algebra. Th author develops the number system, and as he does s uses it to illustrate and develop the concepts of grou ring, field, vector spaces, translations, and matrices. rather high level of mathematical maturity is require to fully appreciate this well-written book. (A- A-3); 4

ARCHER, A.; **Number Principles and Patterns;** Bos ton; Ginn; 1961; 68 pp.

This booklet discusses, from an elementary point view, the non-negative number system through the se of rationals, and the basic properties of these number Included is a discussion of the natural numbers an the four operations of arithmetic, along with the pro erties of commutativity, associativity and distributivit methods of checking, divisibility tests, perfect square prime numbers, and order on the number line. Ther are many exercises to reinforce the ideas involved. Th booklet would probably be most useful for the pr first year algebra student. (Ar); 1

BECKENBACH, E., R. BELLMAN; **An Introduction t Inequalities;** Syracuse; Singer; SMSG; 196 133 pp.

This booklet is an easy to follow, but somewh rigorously written, discussion of inequalities, and som of their more important applications. Starting fro fundamental properties and theorems of algebra, th definition and concepts of inequality are introduce theorems on transitivity and the fundamental opera tions are given, and absolute value and its graph ar discussed; all from a rather formal and deductive poi of view. A section on classical inequalities, whic includes the arithmetic-geometric means inequalit the Cauchy inequality, the Holder inequality, the tr angle inequality, and the Minkowski inequality; an the section on maximum and minimum problems an on distance are rather difficult, and require a mathe matically mature student to fully appreciate these idea (A-2, A-3); 4

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ISTOL, J.; **The Concept of Function;** Boston; Heath; 1963; 66 pp.

This booklet introduces the number system through e set of rationals, discusses the basic concepts of set eory, and approaches the concept of relation and nction both from the point of view of an ordered ir and a mapping. Included is a discussion of the ional numbers and the properties of a field; ordered ir; language and symbolism of sets, and intersecn and union; relation, and domain and range; funcn, the graph test, Cartesian product, converse and verse of a relation and function; the algebra of funcns; composite functions; basic properties of funns; bounded functions; and continuous functions. is booklet is well written and from a modern point view, and could be used as a classroom unit in a secd and third-year algebra course. (A-2, A-3); 3

IRISTIAN, R.; **Introduction to Logic and Sets;** Boston; Ginn; 1958; 70 pp.

This booklet introduces the basic ideas of logic, velops a symbolism for logical constructs, and uses e symbolism and ideas of logic to discuss the basic ncepts of set theory. Included in the discussion on gic are: basic operations of conjunction, disjunction d negation, truth tables, equivalence relations, the gebra of logic, the truth value function, and applitions of logic to electrical systems, logical designs, d switching circuits. Included in the discussion on theory are: notational devices, relations between nditions of equivalence and complements, the albra of conditions, the algebra of sets, quantifiers, and lations between propositions. There are exercises roughout the booklet to reinforce the ideas. This oklet could be used for a classroom unit on logic, obably after a second-year algebra course. (A-2); 3

ANTZIG, T.; **Number, The Language of Science;** Garden City; Doubleday; 1956; 340 pp.

The author's approach in his development of the ncept of number is both from an historical and athematical point of view. He includes in his dission of numbers such topics as the symbolism used r numbers, algorithms of arithmetic, prime numbers, thagorean numbers, Goldbach's conjecture, Fermat's st theorem, irrational numbers, real numbers, Dedend cuts, complex numbers, and transfinite numbers. r. Dantzig then discusses various number problems, ch as bases for numbers, divisibility tests, distribuon of primes, Pythagorean triples, perfect numbers, d graphical solution of equations. This book could read by a first-year algebra student, but most ap-

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preciated by one with more mathematical experien (A-1, A-2, A-3); 3

DAVIS, P.; **The Lore of Large Numbers;** Syracu Singer; SMSG; 1961; 165 pp.

This book discusses methods of writing and ha dling large and small numbers, and offers examples applications of such numbers. Part I includes a discu sion of various bases for numbers, powers and la of exponents, names for very large numbers, metho of approximation, negative exponents and small nu bers, and division by zero. Part II discusses the numb π from an historical and modern point of view, wi 4000 decimal places given, offers divisibility tests f numbers, and discusses residue classes, linear equ tions in n variables, and sequences. An unusual tab of magnitudes frequently used in science and math matics is also given. This book could be understo by the student studying arithmetic, but probably wou be more appreciated after a first-year algebra cour (Ar, A-1); 3

FINE, H.; **The Number System of Algebra;** NY Stechert; 1937; 131 pp.

This book, written in 1890, includes not only rigorous discussion of the number system, but al considerable historical background on the developme of the number system. Although some of the langua used in this book is not fashionable today, the ide certainly are meaningful. Irrational numbers are d fined in terms of an infinite sequence; the polar for of a complex number is treated, along with graphic representation; the fundamental theorem of algeb is proved; convergence of real and complex series discussed; and the exponential and logarithmic fun tion in base e are approached from an infinite seri A high level of mathematical maturity is required order to appreciate some of the latter topics includ in this book. (A-3, C); 5

GELFOND, A.; **The Solution of Equations in Int gers;** San Francisco; Freeman; 1961; 62 pp.

"The determination of integral solutions of algebra equations with integral coefficients and with more tha one unknown is one of the most difficult problems number theory." So says A. O. Gelfond, Professor Mathematics at Moscow University and one of t foremost number theorists in the world. This bookl treats this aspect of number theory, and includes discussion of equations: of one variable, of the fir degree in two variables, of the second degree in thr variables, of the form $x^2 - Ay^2 = 1$, and of degr greater than two in two variables. This booklet

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gorously written, and requires a mathematically ma-
re student to fully appreciate the ideas involved.
A-3); 5

ART, W., V. SCHULT, J. BRISTOL; **Introduction to Sets and Inequality**; Boston; Heath; 1961; 41 pp.

This booklet discusses the elementary concepts of
ts, and uses these ideas to discuss sentences of equality
d inequality in one and two variables. Included is
discussion of set, subset, notational devices for a set,
e number system, intersection and union, algebraic
equalities, theorems on inequality, ordered pair, and
main and range. There are many exercises through-
t the booklet to emphasize the ideas involved. This
oklet could very well be used for an introduction to
ts in a first-year algebra course. (A-1); 1

HNSON, D., W. GLENN; **Adventures in Graphing;** St. Louis; Webster; 1960; 64 pp.

This booklet includes a discussion of ordered pair,
e rectangular coordinate system, relation and func-
on, the linear function, intersection, the distance
rmula, ordered triplet, and a three-dimensional co-
dinate system. It then introduces inequalities of both
o and three dimensions, and has a number of good
oblems on linear programming. There are exercises
roughout to reinforce the ideas. This booklet would
obably be most useful during a sequence on the co-
dinate system in a first-year algebra course. (A-1); 2

HNSON, D., W. GLENN; **Number Patterns;** St. Louis; Webster; 1960; 47 pp.

This booklet includes a discussion of some unusual
umber patterns such as squares of numbers, special
ms and products of integers, divisibility patterns,
d the 1089 problem. It also includes some discus-
on of infinite series, simple and compound interest,
agic squares, and the number $\pi$. There are very good
ercises throughout the booklet to reinforce the ideas
scussed. This booklet would probably be most useful
efore and during a first-year algebra course. (Ar,
-1); 1

HNSON, D., W. GLENN; **Sets, Sentences, and Operations;** St. Louis; Webster; 1960; 63 pp.

Included is a discussion of set, set notation, finite,
finite and empty sets, the universal set, Euler-Venn
iagrams, the operations of union and intersection,
e complementary set, and basic properties of sets.
lso included is a discussion of set concepts in geom-
ry, algebra and logic: sets of points, solution sets
equations and inequalities, sets of ordered pairs,

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relations and functions, and logical syllogisms. I cluded throughout the booklet are many exercises emphasize the ideas discussed. This booklet could used to advantage during a first-year course in algeb (A-1); 2

JOHNSON, D., W. GLENN; **Short Cuts in Compu ing;** St. Louis; Webster; 1960; 46 pp.

This booklet offers a number of tricks for qui calculation in arithmetic. Not only are the short-c methods offered, but also the reasons why they wo are discussed. Included are easy methods for multip ing by 5, 9, 11, 25, two "teen" numbers, and numb near 100; squaring numbers; dividing by 5, 9, 25; a divisibility tests for 2, 3, 4, 5, 7, 8, 9, 11, 13. There a many exercises throughout to practice this short-c arithmetic. This booklet would be most useful bo before a first-year algebra course and during such course. (Ar, A-1); 1

JOHNSON, D., W. GLENN; **Understanding Numer tion Systems;** St. Louis; Webster; 1960; 56 p

Included in this booklet is a discussion of base base 12, and base 2, with a rather lengthy explanati of the operations of addition, subtraction, multiplic tion and division in base 5, and changing from one ba to another. Included in the discussion on base 2 is t game of Nim, and applications to electronic computi machines. There are many exercises throughout t booklet to emphasize the ideas involved. This bookl would probably be very useful before a course in fir year algebra, and during such a course. (Ar, A-1);

JOHNSON, D., W. GLENN; **The World of Measur ment;** St. Louis; Webster; 1960; 64 pp.

This booklet discusses fundamental types of mea ure, such as linear, weight, area, volume, time, ang heat, light, sound and electricity, along with the co responding units of measure. It also discusses worki with measurements: estimating, approximation, a curacy of measurement, significant digits, roundi off, and conversions. Included throughout are ma exercises to emphasize the idea involved. This bookl would probably be most useful before and during first-year algebra course. (Ar, A-1); 1

KOROVKIN, P.; **Inequalities;** NYC; Blaisdell; 196 60 pp.

This booklet discusses, from a sophisticated poi of view, some of the important inequalities that a frequently used in higher mathematics. The approa is a problem-solving one, in that a problem is state and a detailed solution follows. Included are proble

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f the greatest integer inequality; inequalities involvng the geometric, arithmetic, quadratic, harmonic, and xponential means; inequalities involving the number and inequalities related to $(1 + x)^n$. Applications f the above inequalities are then made to maximum nd minimum problems, and to the calculation of cerin limits. A high level of mathematical maturity is equired to fully appreciate this booklet. (A-3, C); 5

RICKENBERGER, W., H. PEARSON; **An Introduction to Sets and the Structure of Algebra;** Boston; Ginn; 1958; 32 pp.

This booklet is divided into two overlapping parts: ne first is an easy to follow discussion of the basic oncepts of set theory, and how this theory may be pplied to an understanding of some of the ideas of robability; the second is a rather formal development f the basic structure of algebra, using the concepts of ets already discussed. Included throughout the booket are many exercises to reinforce the ideas involved. his booklet would probably be most useful during a rst-year algebra course, but could also be used to adantage in a second-year course. (A-1, A-2); 2

IERRILL, H.; **Mathematical Excursions;** NYC; Dover; 1956; 145 pp.

The author discusses, from an elementary point of iew, some of the basic operations of arithmetic and lgebra. Included are topics such as divisibility tests, rime numbers, different bases for numbers, Russian easant's Method of Multiplication, magic squares, ecimal notation, irrational numbers, computation of , geometrical arithmetic, oddities of numbers, equaions with many answers, drawing a line without a uler, and the impossible in mathematics. Most of the naterial in this book could be read by a pre-first-year lgebra student, but would probably be most apprecited by one taking a first or even a second-year algebra ourse. (Ar, A-1, A-2); 2

NICHOLS, E., R. KALIN, H. GARLAND; **Arithmetic of Directed Numbers, A Programed Unit;** NYC; Holt, Rinehart, Winston; 1962; 56 pp.

This booklet is written in the form of a linear programed instruction text on directed numbers; that is, ery specific questions are asked, with perhaps some ntroductory explanation, and the student may go on to he next question (frame) only when he correctly nswers the preceding one. When a student finishes his booklet (413 frames), he should have an undertanding of addition, subtraction, multiplication and livision of numbers over the set of rationals. This ooklet could be used for individual work or as a

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classroom unit for the pre-first-year algebra student. (Ar); 1

NICHOLS, E., R. KALIN, H. GARLAND; **Equations and Inequalities, A Programed Unit**; NYC; Holt, Rinehart, Winston; 1963; 40 pp.

This booklet, written as a linear programed text on an introduction to equations and inequalities, has a total of 284 frames, with a test at the end of the booklet. However, no provision is made for additional explanation and reference if the wrong answer is selected; the student can only redo the same question after having seen the correct answer. Included in the material are ideas involving true and false statements, replacement and solution sets of equations, order of operations and parentheses, solution of equations using absolute value, solution of simple inequalities, and graphing on the number line. The domain throughout is the set of rational numbers. This booklet could be used for individual work or for a classroom unit before or during a first-year algebra course. (Ar, A-1); 1

NICHOLS, E., R. KALIN, H. GARLAND; **Introduction to Sets, A Programed Unit**; NYC; Holt, Rinehart, Winston; 1962; 36 pp.

This booklet is written in the form of a linear programed text on sets; that is, specific questions are asked, and the student may proceed to the next question (frame) only when he correctly answers the preceding one. No provision is made, however, for additional explanation if the wrong answer is selected; the student can only redo the same question, after having seen the correct answer. The ideas which are included in the questions (255 frames) are: basic notion and symbolism for a set; subset; finite and infinite sets; the empty and universal set; operations of union and intersection; Venn diagrams; the complementary set; and one-to-one correspondence of sets. This booklet could be used by an individual or an entire class before or during a first-year algebra course. (Ar, A-1); 1

NIVEN I.; **Number: Rational and Irrational**; Syracuse; Singer; SMSG; 1961; 136 pp.

This book, as the name implies, is a study of the real number system. Included is a discussion of prime numbers and closure over the naturals and integers, of periodic decimals in the set of rationals, and of some geometric and analytical aspects of real numbers, including proofs of the irrationality of $\sqrt{2}$, $\sqrt{3}$, and $\sqrt{6}$. Trigonometric and logarithmic numbers are treated, and thus transcendental numbers are introduced. There is a discussion of approximation of irrationals by rationals, and the existence of transcendental numbers is offered, along with Cantor's proof. Also given are proofs of the infinity of primes and the fundamental theorem of arithmetic. There are many exercises throughout to reinforce the ideas involved. This book is quite rigorously written, particularly the latter parts, and a high level of mathematical maturity is required to fully appreciate the ideas offered. (A-2, A-3, T); 4

Norton, M.; **Basic Concepts of Vectors;** St. Louis; Webster; 1963; 64 pp.

This booklet introduces the basic concepts of vectors, discusses the operations of addition, subtraction and scalar multiplication, discusses basic properties, and offers some practical applications of vectors. Included is a discussion of scalars and vectors, vector addition using the polygon and parallelogram methods, adding three or more vectors, the use of the sine, cosine and tangent ratios to determine the components of vectors, vectors as ordered pairs of numbers; and a discussion of the basic properties of vectors, such as commutativity and associativity of vectors, and distributivity of a scalar over vectors. There are many exercises throughout to reinforce the ideas. This booklet could be used to advantage as a classroom unit on vectors in a first or second-year algebra course. (A-1, A-2); 2

Olds, C.; **Continued Fractions;** Syracuse; Singer; SMSG; 1963; 162 pp.

The author first presents rational fractions, shows how these can be expanded into continued fractions, discusses the expansion of irrational numbers into infinite continued fractions, and then applies the concepts of continued fractions to the solution of Diophantine equations, a theorem from LaGrange, and a theorem from Hurwitz. Included also is a proof that $x^2 - 3y^2 = -1$ has no integral solutions; a number of unusual expansions involving e, $\pi$, and trigonometric functions are given; and there are detailed solutions to exercises that are offered. This book is easily readable, but rigorously written, and requires a mathematically mature student to fully appreciate it. (A-2, A-3, T); 4

Peck, L.; **Secret Codes, Remainder Arithmetic, and Matrices;** Washington, D.C.; NCTM; 1961; 54 pp.

This booklet discusses secret codes, and shows how these codes may be developed and designed using the mathematical concepts of remainder arithmetic and matrices. Included is a rather complete discussion of the modulo number system, with reference to four operations, with subtraction and division defined as inverse operations. The discussion on matrices is also motivated by the construction of secret codes, and the operation of matrix multiplication is given, along with the identity matrix, the inverse of a matrix, and the non-commutativity of matrices. There are many appropriate exercises throughout the booklet to reinforce the ideas involved. This booklet could be used as a classroom unit in a pre-first-year algebra course, for a classroom unit or for individual work in a first-year algebra course, or for a project in a mathematics club. (Ar, A-1); 3

RINGENBERG, L.; **A Portrait of 2;** Washington, D.C.: NCTM; 1956; 41 pp.

This booklet discusses the natural, integral, rational, real and complex number systems, and how a particular element (the number 2) fits into each of these number systems. The author includes in his discussion the distinction between an ordinal and cardinal number, and between a numeral and a number. He uses the concept of an ordered pair of natural numbers to define an integer, and introduces each new, successive set of numbers as an isomorphism between the old and the new sets. The rationals are defined in terms of an ordered pair of integers, and the reals by both a Dedekind partition and convergent sequences. The complex numbers are defined as an ordered pair of real numbers. This booklet could serve as an excellent review and extension of the number system in a second or third-year algebra course. (A-2, A-3); 3

SMITH, D. E.; **Number Stories of Long Ago;** Washington, D.C.; NCTM; 1919; 136 pp.

"This book is intended for supplementary reading in the elementary school. It is written in nontechnical language, and the effort has been made to connect with the history (of numbers) enough of the human element to make it more interesting than any mere recital of facts." From this point of view, Professor Smith tells eight delightful stories about the development of numbers, and offers many number puzzles and problems. Included is a history of numerals and numbers, from ancient Babylonian times to the seventeenth century, and of the development of the processes of addition, subtraction, multiplication and division. This book would probably be most enjoyed by a pre-first-year algebra student, but most appreciated by one taking such a course. (Ar, A-1); 1

SMITH, D. E., J. GINSBURG; **Numbers and Numerals;** Washington, D.C.; NCTM; 1937; 52 pp.

This booklet offers an historical account of numbers and numerals, of methods of computation, fractions, and some curiosities of numbers. Included is an historical development of the names and symbolism given to numbers, with many diagrams and pictures, a discussion of the Chinese Abacus and Japanese Soroban, a development of the methods of multiplication and division of numbers, the mystery of numbers in the Greek and Roman cultures, number patterns, and the derivation of many words used in arithmetic. This historical development of numbers should prove most fascinating for all students of mathematics. (Ar, A-1); 2

SOMINSKII, I.; **The Method of Mathematical Induction;** NYC; Blaisdell; 1961; 57 pp.

This booklet first discusses the concept of induction, states the principle of mathematical induction, and then offers fifty-two problems which are to be proved using the principle, with detailed solutions to twenty-two of them. These problems range from rather easy number problems to very difficult trigonometric problems. The author then proves a number of theorems about arithmetic and geometric sequences, and permutations and combinations. This booklet could be used to great advantage during a classroom unit on the principle of mathematical induction. (A-3); 4

SPRECKELMEYER, R., K. MUSTAIN; **The Natural Numbers;** Boston; Heath; 1963; 63 pp.

This booklet approaches the natural numbers from a deductive and somewhat rigorous point of view. Included is a discussion that builds up to a formal definition of Peano's Postulates; the fundamental operations are defined, and subtraction and division are treated as inverse operations; and the fundamental properties of the natural numbers are discussed, along with order relations and identities. There is a section devoted to binomial coefficients, squares of numbers, partitioning, modulo numbers, and Pythagorean numbers. An appendix treats numeral and number, sets, variables and sentences. This booklet is one of the more formal and modern approaches to natural numbers, and could be used to great advantage both in a first and second-year algebra course. (A-1, A-2); 2

VOROB'EV, N.; **Fibonacci Numbers;** NYC; Blaisdell; 1961; 66 pp.

The thirteenth century mathematician, Leonardo of Pisa, whose surname was Fibonacci, not only introduced the Arabic and Indian ideas of zero, decimal notation, and algebra to the Western world, but also offered the rabbit problem: how many descendants are produced by a single pair of rabbits in one year? From the solution of this problem has developed the theory of Fibonacci numbers, which follow the recursion formula $u_{n+1} = u_n + u_{n-1}$. The author of this booklet first discusses some of the basic properties of Fibonacci numbers, such as the sum of even and odd sequences, and the relation between Fibonacci numbers and binomial coefficients; he then offers number-theoretic properties of Fibonacci numbers, such as the greatest common divisor between two such numbers; he goes on to discuss Fibonacci numbers in continued fractions, and Fibonacci numbers in geometry, such as the "golden section" rectangle. This booklet would probably be useful for independent work in a mathematics club, or for anyone interested in Fibonacci numbers. (A-3); 4

WOODWARD, E., R. MCCLENNAN; **Elementary Concepts of Sets;** NYC; Holt, Rinehart; 1959; 50 pp.

This booklet introduces the concepts of set, subset, intersection and union, and the basic properties of sets, and uses these concepts to discuss algebraic equalities and inequalities in one and two variables, including the absolute value. Included also is the concept of function, with a discussion of domain, range, and the rule for a function. There are many appropriate exercises throughout the booklet to emphasize the ideas involved. This booklet could be used to great advantage to introduce the concepts of set in a first-year algebra course. (A-1); 2

YOUNG, F.; **The Nature of the Regular Polyhedra; Infinity and Beyond; An Introduction to Groups;** Boston; Ginn; 1961; 31 pp.

This booklet is a somewhat sophisticated discussion of the three distinct topics listed in the title. *The Nature of the Regular Polyhedra* discusses and proves Euler's formula $V - E + F = 2$, and then uses it to characterize the regular polyhedra. *Infinity and Beyond* discusses transfinite numbers, and shows that the rational numbers are countable while the real numbers are not. *An Introduction to Groups* discusses the postulates for a field and for a group; offers examples of the rotating square, symmetry of a triangle, and Abelian and cyclic groups; and proves some pertinent theorems in group theory. The approach used in these monographs, particularly in *An Introduction to Groups*, is of such a nature that a rather high level of mathematical maturity is required to appreciate them. (A-2, A-3, G); 4

YOUNG, F.; **Pythagorean Numbers; Congruences, A Finite Arithmetic; Geometry in the Number Plane;** Boston; Ginn; 1961; 30 pp.

This booklet includes a discussion of the three separate and somewhat distinct topics as listed in the title.

*Pythagorean Numbers* develops a systematic method of finding all possible sets of integers a, b, c such that $a^2 + b^2 = c^2$. *Congruences, A Finite Arithmetic* discusses the modulo number system, and includes theorems on prime numbers, prime factorization, and the solution of linear congruences. *Geometry in the Number Plane* discusses lines, slope, and circles over the set of reals, then rationals, then integers, and finally over the set of integers modulus 5. Although the ideas in this booklet are not difficult, the approach is such that it requires a mathematically mature student to understand and follow the discussion, particularly in the abstract theorems offered in *Congruences, A Finite Arithmetic*. (A-2, A-3, G); 4

YOUNG, F.; **Random Numbers; Mathematical Induction; Geometric Numbers**; Boston; Ginn; 1962; 25 pp.

This booklet, as the title indicates, is a discussion of three somewhat unrelated ideas, but intertwined by the concept of a recursive relation. *Random Numbers* includes methods used to arrive at such numbers, and applications to approximation of transcendental numbers, areas, and binomial coefficients. *Mathematical Induction* discusses, in a rather simplified fashion, this powerful mathematical tool, and continues the idea of a recursive relation. *Geometric Numbers* uses the recursive relation and mathematical induction to discuss triangular, square, pentagonal, and cubic numbers. There are a few problems throughout the booklet to reinforce the ideas involved. This booklet could be used as a classroom unit in a third-year algebra course, and *Random Numbers* could be used in an introductory probability and statistics course. (A-3); 3

ZIPPIN, L.; **Uses of Infinity**; Syracuse; Singer; SMSG; 1962; 151 pp.

The author deals with four basic uses of infinity, and as he does so, discusses many and varied important mathematical tools and concepts. As Mr. Zippin discusses the infinity of sets, infinity of natural numbers, infinity associated with the concept of limit, and the infinity of cardinal numbers, he also deals with topics such as sequences, infinities in geometry, the computation of $\sqrt{2}$, incommensurate quantities, limits, the two principal cardinal infinities, the golden mean, induction, and the principle of Dirichlet's boxes, along with many examples, theorems and proofs. This book is easily readable, but rigorously written, and should prove both stimulating and profitable for the mathematically mature student who plans to continue his work in mathematics. (G, A-3, C); 5

## GEOMETRY

Abbott, E.; **Flatland**; NYC; Dover; 1952; 103 pp.

This delightful classic, written around 1880 by a Shakespearean scholar whose hobby was mathematics, is a story about life in a two-dimensional world called Flatland. Here the inhabitants live and think in a not-so-unusual fashion, given their environment. One of them envisions life outside his world, in the lands of Lineland and Spaceland, and then remarks about the difficulties and consequences of living in such strange places. This entertaining book is one that every schoolboy should read, particularly when he is studying Euclidean plane geometry. (G); 1

Archimedes; **Geometrical Solutions Derived From Mechanics,** tr. and ed. by J. L. Heiburg; La Salle; Open Court; 1942; 28 pp.

This treatise by Archimedes, discovered in Constantinople in 1906 by Professor Heiburg, gives us another glimpse at the methods by which Archimedes arrived at some of his mathematical conclusions. This booklet, with an introduction by David Eugene Smith, shows that Archimedes often obtained his results first by intuition and induction, then later verified his results by a strict analytical form of thinking. Included are fourteen propositions related to plane and solid geometry, with discussion of each mainly from a mechanical analogue point of view. This booklet should interest the student who has an historical bent toward mathematics. (G); 4

Bentley, W., E. Potts; **Geometry, Part One: Discovery by Drawing and Measurement;** Boston; Ginn; 1937; 112 pp.

As the title implies, this book is a prelude to a formal course in plane geometry, and it employs the techniques of drawing and measurement to discover many of the facts of geometry. There is first a discussion of point, line, angle, direction, plane and solid. Then the approach is a problem solving one, in that constructions are made, and many of the important facts of angles, triangles, solids, parallel lines, and parallelograms are thus discovered. This book would probably be most useful in a pre-algebra course, and certainly before a deductive course in plane geometry. (Ar); 2

Child, J.; **The Geometrical Lectures of Isaac Barrow;** La Salle; Open Court; 1916; 217 pp.

In the argument over who invented the calculus — Leibniz or Newton — J. M. Child in 1915 submits that it was neither one, but rather Newton's teacher and tutor Isaac Barrow who was the true inventor. In the preface to this book, J. M. Child says, "Isaac Barrow was the inventor of the Infinitesimal Calculus; Newton got the main idea of it from Barrow by personal communication; and Leibniz also was in some measure indebted to Barrow's work, obtaining confirmation of his own original ideas, and suggestions for their further development, from the copy of Barrow's book that he purchased in 1673." This book represents J. M. Child's attempt to substantiate the above quotation. In so doing, he discusses Barrow's predecessors, the works of Barrow, the sources of Barrow's ideas, the mutual influence of Newton and Barrow, and Barrow's Geometrical Lectures I-XIII in order to prove his thesis. This book would probably be most enjoyed by the mathematically mature student with an historical bent toward the subject. (A-3, C); 5

HILBERT, D.; **Foundations of Geometry**; La Salle; Open Court; 1902; 143 pp.

This famous classic, written in 1898, is a formal, rigorous development of Euclidean geometry. Professor Hilbert discusses five groups of axioms: connection, order, parallels, congruence, and continuity. He uses three systems to illustrate these axioms, which he calls points, straight lines, and planes. He then shows the compatibility and independence of these axioms, proves some of the more important theorems of Euclidean geometry which must rely on his axioms, and illustrates the axioms in geometrical constructions. This book requires a high level of mathematical maturity in order to be fully appreciated. (G); 5

JOHNSON, D.; **Curves in Space**; St. Louis; Webster; 1963; 64 pp.

This booklet introduces lines and curves, and planes and surfaces in two and three dimensions, including a rather detailed discussion of the conic sections and their applications. Included is a discussion of points, lines and planes; ordered pair and triplet; distance formula for two and three dimensions; polar coordinates; the circle and the number $\pi$; the parabola, with applications to falling objects; the ellipse, with applications to space travel; the hyperbola, with applications to location; and a discussion of the cycloid, the spiral, the helix, the catenary, and the sine curve. There are many exercises to reinforce the ideas discussed. This booklet could be used as a classroom unit during or after a second-year algebra course (G, A-2, A-3, T); 2

JOHNSON, D.; **Paper Folding for the Mathematics Class;** Washington, D.C.; NCTM; 1957; 32 pp.

This booklet, as the name implies, gives directions for the construction of various geometrical models by paper folding methods. Included is a discussion of the basic constructions in geometry; of geometrical concepts, including the concurrency theorems on triangles; and of circle relationships. The ideas of products and factors are illustrated by means of paper folding, polygon constructions, including the regular polyhedra, are given, the conic sections are discussed, and a section on recreational paper folding is offered. This booklet would probably be most useful on the prealgebra level, although parts of it could be used for illustrative purposes in a deductive course in geometry. (Ar, G); 1

JOHNSON, D., W. GLENN; **The Pythagorean Theorem;** St. Louis; Webster; 1960; 48 pp.

Included in this discussion of the Pythagorean Theorem is an informal proof of the theorem, Pythagorean numbers, similar right triangles, area problems using similarity, approximations to square roots by a recursion formula and by the algorithm, the ratio of the sides in the 30°-60°-90° and 45°-45°-90° triangles, and practical problems using the Pythagorean relationship. This booklet would probably be more useful before a formal course in Euclidean geometry, but could also be used during a development of the Pythagorean Theorem in a deductive sequence. (A-1, G); 1

JOHNSON, D., W. GLENN; **Topology, The Rubber Sheet Geometry;** St. Louis; Webster; 1960; 40 pp.

An easy to understand discussion of some of the basic ideas of topology. Included is a discussion of topological transformations, the Moebius strip, network problems and Euler's formula for networks and regular polyhedra, the four-color map problem, three-dimensional surfaces and the Klein bottle, and many interesting and sometimes unusual exercises. This booklet could be used as a classroom unit after a development on plane and three-dimensional geometry. (G); 1

KAZARINOFF, N.; **Geometric Inequalities;** Syracuse; Singer; SMSG; 1961; 132 pp.

This book first discusses the arithmetic-geometric means inequality in preparation for the central theme and bulk of this book: the isoperimetric theorem, which states that the plane figure of maximum area bounded by a curve of fixed length is the circle. Included is a discussion and proofs of theorems which are special cases of the isoperimetric theorem: for triangles, for quadralaterals, and for polygons of n sides. There is a discussion of the reflection principle, in which the angle of incidence equals the angle of reflection, and how this principle is useful to help solve other cases of the isoperimetric theorem. Included also are many problems, with complete solutions at the back of the book. This book is clearly written, but requires a mathematically mature student to fully appreciate it. (A-2, A-3, G); 4

KLEIN, F.; **Famous Problems of Elementary Geometry**; NYC; Dover; 1956; 92 pp.

This classic offers a sophisticated discussion of the three problems of antiquity (doubling the volume of a cube, trisecting an angle, and squaring a circle) which proves, by algebraic methods, that these three constructions are impossible using only straight-edge and compass. Included is a discussion of algebraic equations solvable by square roots, the duplication of a cube, the trisection of an angle, division of a circle into equal parts, existence of transcendental numbers, the transcendental numbers e and π, and the quadrature of the circle. A high level of mathematical maturity is required to fully appreciate this book. (A-3, G); 5

KOSTOVSKII, A.; **Geometrical Constructions Using Compasses Only**; NYC; Blaisdell; 1961; 79 pp.

This booklet includes a detailed discussion of the various Euclidean geometrical constructions that are possible using only a compass. The approach is a problem-solving one; that is, a problem is stated, and a complete solution (construction) follows. The author first shows that any construction using both ruler and compass can be reduced to one using only a compass. He then discusses inversion and its principal properties, and goes on to discuss other constructions with a fixed maximum radius, and then a fixed minimum radius. This booklet could be useful for mathematics clubs, or for anyone interested in performing more than the usual type of constructions in a Euclidean geometry course. (G); 4

NORTON, M.; **Geometric Constructions**; St. Louis; Webster; 1963; 63 pp.

This booklet introduces the concept of geometric constructions, discusses when such constructions are possible, performs many of the basic constructions of Euclidean geometry, discusses the famous problems of

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ntiquity, and offers some unusual constructions. Included are constructions applicable to arithmetic and lgebra, such as the four operations and square root onstructions; a discussion of the properties of commutativity, associativity, and distributivity in construcions; twenty-eight basic constructions of geometry; luplication of the cube, squaring the circle, and risecting an angle are discussed; and special contructions are offered, such as the golden section, the ine-point circle, and designs. There are a few construcions for the student to consider also. This booklet ould be used as a classroom unit during a formal geometry course. (A-1, G); 2

ORE, O.: **Graphs and their Uses;** Syracuse; Singer; SMSG; 1963; 131 pp.

Professor Ore, in his introduction, distinguishes between graphs of analytical geometry or function theory and the kind he discusses in this book by saying, "The graphs we are about to study . . . are simply geometrical figures consisting of points and lines connecting some of these points; they are sometimes called 'linear graphs'." From this point of view, Dr. Ore discusses the theory of graphs and their applications to such diverse problems as: matchings, such as round-robin matchings; transportation problems, such as one-way traffic control; network problems, such as Euler's Königsberg Bridge problem; games and puzzles; and the four-color map problem. This book is rigorously written, and would be most appreciated by the mathematically mature student who is interested in this branch of topology. (G, A-2, A-3); 4

SMOGORZHEVSKII, A.: **The Ruler in Geometrical Constructions;** NYC; Blaisdell; 1961; 86 pp.

This booklet is a sophisticated discussion of certain theorems from synthetic and projective geometry, and their applications to geometrical constructions with only the aid of a ruler. Included in the synthetic and projective geometry section is a discussion of inverse with respect to a circle, power of a point with respect to a circle, radical axis of two circles, pencils of straight lines, harmonic properties of a complete quadrangle, polar properties of conic sections, and a theorem from Brianchon and from Pascal. Part II consists of thirty-six construction problems with only a ruler, based on the earlier discussion of synthetic and projective geometry. This booklet is excellent for the mathematically mature student who is interested in projective geometry, and in constructions not usually performed in a one-year Euclidean geometry course. (G); 5

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WELCHONS, A., W. KRICKENBERGER, H. PEARSO
**Essentials of Solid Geometry, Including Spherical Geometry;** Boston; Ginn; 1959; 124 pp.

This booklet develops the more important theorem of three-dimensional geometry in a formal, deductiv fashion, and includes a unit on spherical geometry an three-dimensional coordinate geometry. It was writte to supplement the authors' *Plane Geometry* text; it i written in such a way so that it may be integrated wit a plane geometry course, or used as a separate uni after such a course. There are many, well-graded exercises throughout to reinforce the ideas and theorems This booklet could very well be used as a text for soli geometry during or after a deductive course in plan geometry. (G); 3

YAGLOM, I.; **Geometric Transformations;** tr. by A Shields; Syracuse; Singer; SMSG; 1962; 133 pp

The author discusses the geometric transformations of translations, rotations and reflections, and as he does so, develops some important concepts and theorems about groups. The approach is mainly a problem-solving one, in that after a rather brief introduction of a concept is given, a number of problems are offered to supplement these introductory remarks. Also, detailed solutions to all problems are given at the back of the book. There are forty-seven such problems that are quite difficult, and will make demands on the mathematically mature student who has already studied plane geometry. (G); 5

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## PROBABILITY AND STATISTICS

OHNSON, D.; **Probability and Chance**; St. Louis; Webster; 1963; 63 pp.

This booklet introduces some of the basic concepts of probability and offers applications of these concepts, ll from a set theoretic point of view. Included is a definition of probability; a discussion of a sample space, binomial coefficients and Pascal's triangle; a rather detailed discussion of permutations and combinations, complementary, independent and mutually exclusive events, mathematical expectation, and the normal distribution. There are experiments conducted, both for equally likely and non-equally likely outcomes, in order to explain the material, and there are many exercises given in order to reinforce the ideas. This booklet could be used as a classroom unit after a first-year algebra course, but perhaps more profitably after a second year course. (A-1, A-2); 2

JOHNSON, D., W. GLENN; **The World of Statistics**; St. Louis; Webster; 1960; 64 pp.

Included in this booklet on statistics is a discussion of samples, frequency distribution, graphs, and a frequency polygon; the mode, mean and median as measures of central tendency; the range and standard deviation as measures of spread or dispersion; the normal distribution and the normal curve; and a discussion of the relationship between two sets of data, the correlation coefficient. There are many exercises given to reinforce the ideas discussed. This booklet would probably be most useful after a second-year algebra course, although the mathematics involved, except for occasional notation, is nothing more than arithmetic. (A-1, A-2); 2

MORONEY, M.; **Facts From Figures**; Baltimore; Penguin; 1951; 470 pp.

This is a rather sophisticated but easily readable book on probability and statistics presented from an analytical point of view. Included are the topics of permutations, combinations, measures of central tendency and of variability, the binomial, Poisson, and normal distributions, sampling techniques, tests of significance, confidence limits, the chi square distribution, correlation and variation. There are many examples given throughout the book to better understand and follow the discussion. Although the approach used in this book is somewhat out of fashion at the present time, the ideas involved are certainly meaningful today. This book would be excellent for collateral reading during a semester course in probability and statistics. (A-3); 4

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**Weaver, W.; Lady Luck; The Theory of Probability**; Garden City; Doubleday; 1963; 392 pp

This is an easily readable but somewhat sophisticated approach to the theory of probability and statistics from the set theoretic point of view. Dr. Weaver first points out the distinction and relation between classical, deductive thinking, and that kind of reasoning necessary for work in probability. He then defines mathematical probability, and thereafter discusses and develops the theory of probability. Included in this development is a discussion of permutations, combinations, events (independent, mutually exclusive, converse), mathematical expectation, measures of central tendency, variability, binomial experiments, the normal distribution and the Poisson distribution. He then points out again the distinction between probability and statistics, discussing sampling techniques, models, and statistical inference. He uses many examples throughout the book, and discusses some famous problems, such as Bernoulli's problem, the first play problem, the birthday problem, Montmort's problem, and gambling problems. This book would be excellent for collateral reading during a semester course in probability and statistics. (A-3); 4

## COMPUTING MACHINES

**Adler, I.; Thinking Machines;** NYC; New American Library; 1961; 159 pp.

This book explains, in an easily readable fashion, the fundamental theory of computers, and the mathematics behind them. Included is a discussion of numbers and numerals, the binary number system, basic properties of numbers, the algebra of numbers, of sets, and of sentences, truth tables and Boolean algebra, and their applications to mechanical calculators, switching circuits, and electronic computers. This book takes some of the mystery out of computing machines, and can be appreciated by anyone after a second-year algebra course. (A-2); 3

**Johnson, D., W. Glenn; Computing Devices;** St. Louis; Webster; 1960; 55 pp.

This booklet includes a discussion of finger counting, ancient computing devices such as the Chinese abacus and Japanese soroban, and Napier's rods. It also discusses exponents and common logarithms, the slide rule, nomographs, the binary number system, and modern electronic computers. There are some exercises throughout the booklet to reinforce the ideas involved. This booklet would probably be most meaningful for the first-year algebra student, but could very well be used before such a course. (A-1); 1

**Gorn, S., W. Manheimer; The Electronic Brain and What It Can Do;** Chicago; Science Research Associates; 1956; 63 pp.

This booklet, written in an elementary fashion, discusses the basic techniques and methods by which an electronic computer operates, and the uses of such machines. Included is a discussion of the binary number system, two examples showing how to construct a simple program, the elements of a computer and their corresponding functions, and the coding and control of a digital computer. This booklet is for the student who is interested in the basic facts of digital computers. (A-1); 1

**Young, F.; Digital Computers and Related Mathematics;** Boston; Ginn; 1961; 40 pp.

This booklet is divided into three parts. The first part, *The Digital Computer, Key to a New World,* is an introduction to the nature and operation of digital computers, with specific reference to the IBM 650. A number of programs are presented, ranging from a simple program to the construction of a "loop". The second part, *The Algebra of Sets, Logic, and Switching Circuits,* discusses the basic properties of algebra, and then the basic properties of Boolean algebra. Applications of Boolean algebra to sets, logic and switching circuits are then presented. *The Logical Design of Digital Computers* discusses the binary number system, and shows how a Boolean algebra is used to design a digital computer. There are numerous exercises throughout to reinforce the ideas involved. This booklet could be used as a classroom unit, for individual work in a mathematics club, or simply for outside reading. (A-2); 3

## RECREATIONAL

ADLER, I.; **Magic House of Numbers**; NYC; New American Library; 1957; 123 pp.

This book may be divided into two parts: the first part discusses the natural numbers and operations on them, and the second part consists of mathematical puzzles, card tricks, and number games. The first part includes number patterns, various bases for numbers, and square, triangular, cubic and perfect numbers. The second part includes puzzles with and without numbers, quick calculating tricks, card tricks, and various games, such as the Towers of Hanoi, Chinese Rings, and the game of Nim. This book should prove enjoyable not only for the mathematics student, but for anyone intrigued by number patterns, games and puzzles. (A-1); 1

GARDNER, M.; **Mathematics, Magic and Mystery**; NYC; Dover; 1955; 174 pp.

This is a book of tricks, games and puzzles based mostly on mathematical principles, with emphasis on how to perform them rather than on why they work. Included are many card tricks; tricks using dice, dominoes, calendars, watches, dollar bills, matches, coins and checkerboards; topological tricks and games using a handkerchief or a piece of string; geometrical puzzles such as line and area paradoxes; and magical number tricks, such as rapid cube root extraction, adding a Fibonacci series and guessing someone's age. These are tricks that one can learn and play on others, or simply read and enjoy. (A-1); 1

HEATH, R.; **Mathemagic**, ed. by Jerome S. Meyer; NYC; Dover; 1953; 138 pp.

*Mathemagic*, as the name implies, is a book about the magic of numbers written by a member of the Society of American Magicians. There are fifty-four "magical tricks" that one can easily learn and play on his friends, or simply read and enjoy. They range from number tricks (think of a number type) to number arrangements (the magic number 142857), easy ways to multiply, magic squares, a method of determining the day of any date, and a short-cut interest method. This book can be read and enjoyed by anyone. (A-1); 1

JOHNSON, D., W. GLENN; **Fun With Mathematics**; St. Louis; Webster; 1960; 43 pp.

This booklet offers a number of mathematical games and magical tricks mostly with the use of numbers, plus an algebraic explanation of why they work. Included are tricks such as "pick a number", the lucky number 5, guessing one's birthday, guessing one's age, odd and even number tricks, and squaring a number. There are games about the calendar, such as finding Easter Sunday; games about the clock, and games using cards, dice and dominoes, and a disappearing area trick. There are some additional tricks and games given as exercises for the student to practice on himself and others. This booklet would probably be most appreciated by a pre-first-year algebra student, but more understood by one taking such a course. (A-1); 1

Loyd, S.; **Mathematical Puzzles of Sam Loyd,** ed. by Martin Gardner; NYC; Dover; 1959; 167 pp.

Sam Loyd invented thousands of ingenious puzzles around the turn of the century, and after his death, his son issued a vast collection of these entitled *Cyclopedia of Puzzles*. Martin Gardner, editor and author, selected the best mathematical puzzles from this cyclopedia, with original line drawings and diagrams, and presents them in this delightful book. There are 117 puzzles given, with solutions to each at the back of the book. A feature of this book is that the table of contents classifies the puzzles according to arithmetic and algebra problems, probability and game theory problems, plane geometry problems, topographical problems, and solid geometry problems. This book would be appreciated not only by the first-year algebra student, but by anyone who enjoys puzzles. (A-1); 2

Meyer, J.; **Fun With Mathematics;** NYC; Fawcett; 1952; 176 pp.

This book discusses, in a clear and easily readable fashion, the world of numbers. Included is a discussion of the meaning and use of large and small numbers; of other bases for numbers; of number facts, curiosities and patterns; of magical numbers; of powers of numbers; of Fibonacci numbers; and of $\pi$, i, e, and the logarithms of numbers. There is also a discussion of the nomograph, how to make a slide rule, the conic sections, and mathematical fallacies and problems, including the three problems of antiquity. This book should prove to be interesting and enjoyable reading for everyone, but probably most appreciated by the third-year algebra student. (A-1, A-2, A-3, G, T); 3

Mott-Smith, G.; **Mathematical Puzzles for Beginners and Enthusiasts;** NYC; Dover; 1954; 248 pp.

This delightful book of mathematical puzzles includes 188 problems ranging from easy puzzles to difficult problems, with solutions to each at the back of the book, along with a discussion of the mathematical concepts involved. The puzzles are arranged according to topics: mental arithmetic, logic, algebra, plane geometry, properties of digits and integers, decimals, permutations and combinations, and probability. This book is not only for the mathematics student, but for anyone who enjoys mathematical games and puzzles. (A-1); 2

REINFELD, D., D. RICE; **101 Mathematical Puzzles;** NYC; Cornerstone; 1962; 123 pp.

The 101 mathematical puzzles in this book range from very easy to somewhat difficult arithmetic and algebraic problems, with the solution and a mathematical explanation of each at the back of the book. The puzzles are arranged in order of difficulty, but no attempt has been made to classify them according to topics. This book is designed more for the beginner puzzle enthusiast, but certainly anyone intrigued by mathematical puzzles will enjoy this book. (A-1); 1

TOCQUET, R.; **The Magic of Numbers;** NYC; Fawcett; 1957; 159 pp.

This book discusses, in an easily readable fashion, some fascinating aspects of number patterns, and their applications to rapid mental arithmetic, mathematical puzzles, and some unusual problems. Included is a discussion about people who possess lightening-quick calculating ability, and attempts to understand this phenomenon; of simulated mental calculation, following number patterns from arithmetic; of mathematical tricks using the properties of numbers; of some unusual problems, such as the string around the earth problem and the milkmaid's measure problem; and of calculations performed by animals, and how this is done. This book should be enjoyed by anyone who is interested in the magic of numbers. (A-1, A-2); 2

## GENERAL

Brant, V., M. Keedy; **Elementary Logic for Secondary Schools;** NYC; Holt, Rinehart, Winston; 1962; 123 pp.

This booklet introduces some of the basic concepts and ideas of logic, and through examples, illustrates the use of logic in sentences, algebra, and geometry. Included is a discussion of inductive and deductive reasoning; Venn diagrams; sentences using conjunction, disjunction, negation and equivalence; truth tables; tautologies; validity of arguments by means of truth tables; universal and existential quantifiers; and theorems and methods of proof. There are many good exercises throughout the booklet, with accompanying answers at the back, plus a bibliography. This booklet could be used as a classroom unit on introductory logic after a first-year algebra course, or before and during a formal geometry course. (A-1, G); 3

Court, N.; **Mathematics in Fun and Earnest;** NYC; New American Library; 1961; 250 pp.

Mr. Court approaches the subject of mathematics mainly from a philosophical and metamathematical point of view. Included are topics such as deductive reasoning and axiomatic systems, with reference to Euclidean and Non-Euclidean geometry, and metrical and projective geometry; infinity, with examples from numbers, Non-Euclidean and projective geometry, and time and motion; aesthetics, with illustrations from music and poetry; logic and rigor, with discussion of Formalism versus Intuitionism. Also included is a discussion of famous problems, such as Morley's problem, the problem of Appolonius, Fermat's last theorem, and Goldbach's conjecture. This book, although easily readable, would probably be more appreciated by the mathematically mature student. (G, A-3); 4

Gamow, G.; **One, Two, Three—Infinity;** NYC; New American Library; 1947; 314 pp.

Although the author is primarily concerned with facts and theories of modern science and of the universe, the student of mathematics will particularly enjoy the discussion about numbers (large, transfinite, prime, complex), topology (Euler's formula, the four-color problem, Mobius strip, Klein bottle), the fourth dimension, relativity, and probability and statistics. The mathematical ideas in this book could be read by a first-year algebra student, but would probably be most appreciated by one with more mathematical experience. (A-1, A-2, G); 3

HESS, A.; **Mathematics Project Handbook**; Boston; Heath; 1962; 60 pp.

This *Mathematics Project Handbook* offers information, suggestions, titles, references and a bibliography for mathematics projects designed to be exhibited at a Science and Mathematics Fair. It answers the questions of what, why, where and how of mathematics projects, and discusses a number of topics to help prepare and plan a project. This booklet should prove invaluable for both the student and teacher who is involved in mathematics clubs, projects, and fairs. (A-1, A-2, A-3, G, T, C); 1

JOHNSON, D., W. GLENN; **Invitation to Mathematics**; St. Louis; Webster; 1960; 64 pp.

This booklet surveys the various branches of mathematics and offers capsule biographies of outstanding mathematicians. Included is a brief description of inductive and deductive reasoning, logic and an axiomatic system, modular arithmetic, Non-Euclidean geometries, trigonometry, algebra, probability and statistics, and the calculus. Also included is a discussion of unsolved problems, such as Goldbach's conjecture, Fermat's last theorem, the three construction problems of geometry, and the four-color map problem. There are short biographies of Archimedes, Leibniz, Gauss, Einstein, Descartes, Newton, and von Neumann. This booklet is for the freshman student who wonders what he will study in mathematics. (A-1); 1

JOHNSON, D.; **Logic and Reasoning in Mathematics**; St. Louis; Webster; 1963; 64 pp.

This booklet discusses important logical constructs and applies and illustrates these in arithmetic, algebra and geometry. Included is a distinction between inductive and deductive thinking; a discussion of logical syllogisms and the use of Euler diagrams; the distinction and relation between a statement and its converse, inverse and contrapositive; indirect proof; the structure of an axiomatic system, with undefined terms, defined terms, assumptions and theorems, along with a theory of inference; examples of systems in arithmetic, algebra and geometry; and a discussion of truth tables for negation, conjunction, disjunction, and implication. There are many exercises throughout to reinforce and supplement the ideas discussed. This booklet could be used as a classroom unit to develop the concepts of logic and an axiomatic system during a first-year algebra course, or before and during a formal geometry course. (A-1, G); 2

KRAMER, E.; **The Main Stream of Mathematics;** NYC; Fawcett; 1961; 352 pp.

This book discusses important concepts of mathematics and their influence on modern science. The author's approach is from an historical, mathematical and practical point of view. Included are topics such as number (symbolism, different bases, Pythagorean numbers, real numbers, complex numbers); Euclidean geometry and its influence on art and aesthetics; properties of algebra and their application to radar and Einstein's mass-energy formula; trigonometry and its application to sound, electricity and light; analytical geometry and its impact upon the calculus; probability and statistics; and a discussion of logic and an axiomatic system, relativity, and infinity. This book would probably be most appreciated by the more experienced mathematics student. (A-2, A-3, T, C); 3

MUIR, J.; **Of Men and Numbers;** NYC; Dell; 1961; 288 pp.

In this book, Jane Muir not only presents a biography of twelve great mathematicians and their contributions to mathematics, but at the same time, she traces the development and evolution of mathematical thought from the sixth century B.C. to the present time. Included are biographies of Pythagoras, Euclid, Archimedes, Cardano, Descartes, Pascal, Newton, Euler, Gauss, Lobatchevsky, Galois, and Cantor. This book should prove fascinating for any student of mathematics but most appreciated by one who has studied algebra and geometry. (A-1, A-2, G); 2

NORTON, M.; **Finite Mathematical Systems;** St. Louis; Webster; 1963; 64 pp.

The author discusses modular arithmetic in base 7, and abstract algebraic systems to show and develop the basic properties of a group, and then discusses finite geometric systems. Included in the modular arithmetic discussion are the basic properties of commutativity, associativity, distributivity, closure; and identity and inverse elements for multiplication and addition. A clever example of an abstract system which possesses the properties of a group is discussed, and three finite geometries are developed as axiomatic systems. Included throughout are very good exercises to reinforce the ideas. The finite geometry examples could be used as a classroom unit before or after a formal geometry course to illustrate axiomatic systems, and the rest of the booklet could be used in a first or second-year algebra course in order to show structure in algebra. (A-1, A-2, G); 2

SALKIND, C.; **The Contest Problem Book**; Syracuse; Singer; SMSG; 1961; 154 pp.

The problems of the annual high school contests of the Mathematical Association of America from 1950-1960 were compiled and solved by Mr. Salkind and made into this book. The problems are arranged in chronological order of the tests, with complete solutions at the back of the book, but an added feature is a detailed classification of problems for easy reference and selection. The problems range from easy to very difficult, and should prove stimulating and helpful for both the student and teacher of mathematics. (Ar, A-1, A-2, A-3, G); 4

SAWYER, W.; **Mathematician's Delight**; Baltimore; Penguin; 1943; 237 pp.

From his approach to mathematics (the nature of reasoning), to his discussion of topics from arithmetic, algebra, geometry, trigonometry and calculus, W. W. Sawyer carefully leads and guides the reader. Specific topics include decimals, logarithms, exponential equations, binomial coefficients, graphs, the study of speed, the study of curves, trigonometric functions and formulas, sequences and series, the exponential function $e^x$, and complex numbers. This book could be read by a first-year algebra student, but would be most appreciated by one with more mathematical experience. (A-1, A-2, A-3, T, C); 3

SAWYER, W.; **What is Calculus About?**; Syracuse; Singer; SMSG; 1961; 118 pp.

This book introduces, in an intuitive way, the basic ideas of the calculus. Included is a discussion of velocity of a particle, rates of change, acceleration, and a procedure for determining velocity which turns out to be the definition of the derivative without it being called such. Also included are procedures for finding the first derivative of any polynomial, a graphical interpretation of the derivative, and acceleration and curvature to introduce the second derivative of a polynomial. The reverse problem, that is, the integral, is considered, as are maximum and minimum problems. There is a section on intuition and logic, which points the way toward the necessity of a more rigorous and logical approach to the calculus. Because of the method of presentation, this book could be used to great advantage after a second-year algebra course. (A-2); 3

SHUBIK, M.; **Readings in Game Theory and Political Behavior**; Garden City; Doubleday; 1954; 74 pp.

This booklet, which consists of ten essays, describes some of the methods and models by which a mathematically oriented political scientist or economist handles and solves some of the varied problems that face him today. Included is a discussion of the role of mathematics in the social and political sciences, with emphasis on game theory, decision-making and strategy problems; along with the mathematical models and methods of analysis of these situations. These essays offer the mathematically mature student new approaches to, uses for, and applications of mathematics that he perhaps never considered or even dreamt possible. (A-3); 5

STRADER, W.; **Five Little Stories;** Washington, D.C.; NCTM; 1960; 16 pp.

The five little, delightful stories in this booklet are: *An Unbelievable Month of September,* a study of the changes in our calendar, with specific reference to September 1752, which contained only nineteen days; *Napier's Bones,* a discussion of a mechanical means of multiplication based on the Gelosia method; *Why X is Used for the Unknown,* an historical development of the prevalence of the letter X; *A Colossal, Enormous, Stupendous Number,* an appreciation of the tremendous magnitude of the largest number that can be written with three digits; *The Strange Reciprocal of Seventeen,* a discussion of the cyclic nature of rational numbers. Included also at the end of each story is a bibliography for further reading. This booklet should be enjoyed by everyone, and particularly by the pre-first-year algebra student. (Ar); 1

TITCHMARSH, E.; **Mathematics for the General Reader;** Garden City; Doubleday; 1959; 197 pp.

This book, written in a most readable fashion, offers a sampling of important and basic ideas from arithmetic, algebra, geometry, trigonometry and calculus, with number as the thread that weaves and holds the ideas together. Included is a discussion of fractions, use of numbers in geometry, irrational numbers, exponents and logarithms, infinite series, $\pi$ and e, complex numbers, functions, and differential and integral calculus. This book shows the pervasiveness of the concept of number in mathematics, and would probably be most appreciated by the more advanced student of mathematics. (A-2, A-3, T, C); 3

USPENSKII, V.; **Some Applications of Mechanics to Mathematics;** NYC; Blaisdell; 1961; 58 pp.

The applications of mathematics to mechanics are well-known, but this booklet shows how mechanical models may be used to show and prove some basic laws and theorems in mathematics. Included are mechanical analogues for the solution of such problems as: tangents to circles, ellipses, parabolas, and hyperbolas; intersection of two straight lines; and a problem from the theory of numbers. There are mechanical models given to discuss the principle of least potential energy, the center of gravity, and the impossibility of perpetual motion. This booklet would be useful for a mathematics club, or for anyone interested in a physical interpretation and proof of some theorems in mathematics. (G, A-3); 4

VERGARA, W.; **Mathematics in Everyday Things;** NYC; New American Library; 1959; 300 pp.

This book, as the title suggests, shows how mathematics may be used to answer questions related to the physical world. The book is written in a question-answer form, and there is a potpourri of topics ranging from number theory, to laws of physics and astronomy, to probability, and to Non-Euclidean geometry. Answers to questions as "Why does the whistle of a moving train seem to change pitch as it travels by us?", "How did the musical scale evolve?", and "Are parallel lines really parallel?" are clearly and simply, if sometimes superficially, written. This book could serve as an excellent source book for oft-repeated questions about the universe. (A-1, A-2, G, T); 3

WHITEHEAD, A.; **Science and the Modern World;** NYC; New American Library; 1925; 212 pp.

This book is a philosophical discussion of science and its impact on the modern world. Originally delivered as the Lowell Lectures at Harvard University in 1925, this book includes an historical review of mathematics and science in the seventeenth, eighteenth, and nineteenth centuries; discusses relativity and the quantum theory; and discusses the relationship between science and philosophy, science and religion, and science and society. This is a timeless book that every serious would-be mathematician and scientist should read and have in his permanent library. (A-2, A-3); 3

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**SCHOOL**
**MATHEMATICS**
**STUDY GROUP**

# Newsletter No. 18

*April 1964*

## SMSG PUBLICATIONS

# CONTENTS

NEW PUBLICATIONS, 3

- MATHEMATICS FOR THE ELEMENTARY SCHOOL, 4
- ANALYTICAL GEOMETRY, 7
- MATHEMATICS THROUGH SCIENCE, 8
- THE SMSG PROGRAMED LEARNING PROJECT, 9

ORDER FORMS, Insert

- REVISED EDITIONS
- PRELIMINARY EDITIONS

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A number of new SMSG textbooks will be made available for general classroom use for the school year 1964-65. These consist of student texts and teacher's commentaries for the primary grades, units for grades 7-9 which use physical science to motivate certain mathematical ideas, a programed first course in algebra, and a senior level one-semester text in analytic geometry.

Preliminary versions of these are now receiving classroom tryout. They all will be revised during the summer of 1964.

Copies of these preliminary versions can now be ordered for inspection. These are *not* for classroom use. Please use the order form on insert page.

The inspection copies of the primary materials consist of the teacher commentaries, which include the pages of the student texts. The Mathematics Through Science materials are bound together in one book for the student version and one for the teacher commentary. The student text and teacher commentary will be sold only as a unit.

Except for the Mathematics Through Science, each of the revised texts will appear in two or three parts. In the case of orders received by July 1, 1964, the first part will be delivered by September 1, and the remaining parts during the fall. Orders received after July 1 will be filled as rapidly as possible but September 1 delivery cannot be guaranteed.

To order classroom sets of revised versions please use the order form on insert page.

Brief descriptions of these texts will be found on the following pages.

## MATHEMATICS FOR THE ELEMENTARY SCHOOL, Grades K-3

The School Mathematics Study Group began its work on a mathematics program for the elementary school in the spring and summer of 1960. First attention was directed principally to the development of materials for grades 4, 5 and 6. This phase of the project was completed by the end of the summer of 1962. Student texts and teacher's commentaries for *Mathematics for the Elementary School,* Grades 4-6 now are in general classroom use. (Available from Yale University Press, School Mathematics Study Group, 92A Yale Station, New Haven, Connecticut.)

The summer of 1962 also marked the beginning of work on the development of materials for the kindergarten and grades 1, 2 and 3. Progress reports on this phase of the project appeared in *The Arithmetic Teacher* (December 1962, pp. 459-61 and December 1963, pp. 514-16). Briefly, the materials developed during the summer of 1962 were used in experimental classes during the 1962-63 school year. Reports from participating teachers provided the basis for a revision and extension of the K-3 materials during an 8-week writing session in the summer of 1963. This second version of the K-3 materials has been used in experimental classes during the current 1963-64 school year and now is being made available in a special examination edition for those who wish to become familiar with the project materials in their current stage of development.

The following things are included for each of the indicated grade levels in the examination edition:

**KINDERGARTEN.** A *commentary for the teacher,* with mathematical background and instructional suggestions organized in the following sections:

1. Sets
2. Recognizing Geometric Shapes
3. Comparison of Sets
4. Subsets
5. Joining and Removing
6. Ordering
7. Using Geometric Shapes for Directions and Games
8. Using Numbers with Sets

**GRADE 1.** A *book for the pupil* and a *commentary for the teacher,* with mathematical background and instructional suggestions organized under the following chapter headings:

1. Pre-Number Experiences
2. Recognizing Geometric Shapes
3. Building Number Concepts
4. Pre-Addition and Subtraction Experiences
5. Numerals and the Number Line
6. Comparing Geometric Shapes
7. Addition and Subtraction
8. Place Value and Numeration
9. Introducing Linear Measurement
10. Extending Addition and Subtraction
11. Previews and Extensions

**GRADE 2.** A *book for the pupil* and a *commentary for the teacher,* with mathematical background and instructional suggestions organized under the following chapter headings:

1. Sets and Numbers: Review and Extension
2. Addition and Subtraction: Review with Emphasis on Properties
3. Linear Measurement
4. Extending Addition and Subtraction
5. Sets of Points
6. Addition and Subtraction: Computing Sums and Differences
7. Congruence of Geometric Figures
8. Introduction to Multiplication and Division

**GRADE 3.** A *book for the pupil* and a *commentary for the teacher,* with mathematical background and instructional suggestions organized under the following chapter headings:

1. Review and Extension of Addition and Subtraction
2. Sets of Points
3. Addition and Subtraction Techniques
4. Addition and Subtraction: Shorter Forms of Computation
5. Multiplication and Division
6. Coordinates
7. Measurement of Length and Area

Also, supplements for more able pupils.

**Special Notes.**

1. This examination edition of *Mathematics for the Elementary School, K-3* does not represent the final version of the materials for these grades. Again this summer a writing team will spend eight weeks revising and expanding the student texts and the teacher's commentaries, based principally on reactions and evaluations received from participating teachers in the project centers. Even now, however, certain things are recognized as necessary in this connection. For example:

a. In their present form most pages of the pupil books are essentially worksheets to be used following a teacher's presentation or exploration with pupils. In the final form more of the pages in the pupil books will undoubtedly be developmental in nature.

b. No work with rational numbers is included in the current version of materials for grades K-3. Some such work is decidedly appropriate, however, and will be included in the subsequent version of *Mathematics for the Elementary School*, K-3.

c. Activities and experiences pertaining to such applications as weight, time, volume, temperature, and money will be included in the final version.

2. One should keep the following fact well in mind: When the *4th* grade text of *Mathematics for the Elementary School* was prepared, it could *not* be assumed that children using it would already have the kind of background represented by the K-3 materials that now exist. Thus, much of that background had to be included, in suitable form, as part of the 4th grade text. Consequently, certain sections of the 4th grade text should be viewed quite differently for children who will have the K-3 background in the future, and its use should be modified accordingly. This also may lead to adjustments in use of the 5th and 6th grade texts. Even when the revised edition of the K-3 materials becomes available for general classroom use in the fall of 1964, the complete series — *Mathematics for the Elementary School, K-6* — should be used only with judicious modifications that take into account the fact that the K-3 texts and the 4-6 texts were prepared at different times under somewhat different circumstances.

3. In-service classes pertaining to the mathematical content of the K-3 program have been held for the participating teachers in the project centers. These have been indispendable. It simply is not possible to implement a program of the kind reflected in *Mathematics for the Elementary School, K-3* without undergirding it with a substantial program of in-service training for the teachers involved.

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## ANALYTIC GEOMETRY

SMSG has received many requests for a one-semester nior level analytic geometry text and a number of asons have been advanced for these requests. It is mmon practice to include in the beginning university lculus course just enough analytic geometry for this rpose. The result has been that much analytic geomry formerly taught is now omitted, and what is coved is done hurriedly. Much of the beauty and value of alytic geometry is thereby lost.

Many high school teachers feel that the final high hool mathematics course should emphasize a review algebra and geometry. A course in analytic geometry an ideal vehicle for such a review since it necessarily es the important ideas and techniques of both algea and geometry but in a new and interesting setting.

Finally, there are many cases in which a class finishes e basic pre-calculus sequence before the end of the st year of high school and, for one reason or another, e teacher feels it is not advisable to begin the study calculus. The SMSG Advisory Board has never felt at there is one preferred course for such situations nd, in fact, believes that any course which takes up ood, sound mathematics is satisfactory. There are any possible topics for such courses, including probbility, number theory, modern algebra, matrix theory nd, of course, analytic geometry. In any particular case e choice should be based on the interests and capalities of the students and the teachers and on the ailability of suitable text materials. The present text resupposes a study of algebra, geometry, and trignometry along the lines exemplified in earlier SMSG xts.

**hapter Headings:**

1. What is Analytic Geometry
2. Coordinates and the Line
3. Vectors and their Applications
4. Points, Lines, and Planes
5. Curve Sketching and Locus Problems
6. Conic Sections
7. Space, Surfaces, and Curves
8. Transformations

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## MATHEMATICS THROUGH SCIENCE

The School Mathematics Study Group has been e
ploring the possibility of introducing some of the bas
concepts of mathematics through very simple scien
experiments. Under the title *Mathematics Throu*
*Science* several units have been prepared. It is believ
that student learning and understanding may be i
proved by inserting one or more of these from ti
to time in the mathematics course. They are design
to be usable with any mathematics textbook common
in use. They do not replace the textbook of a cour
but supplement it.

Previous acquaintance with science on the part
the student is unnecessary. In preparing the units, me
bers of the writing team actually performed every o
of the experiments suggested, not once but seve
times. Young people of junior high school age al
repeated most of them, usually working in pairs. E
fort has been made to make the directions for t
conduct of the experiments clear and simple, a
apparatus has been kept to a minimum.

Each experiment opens a door into a new doma
of mathematics: measurement, inequalities, the nu
ber line, equation and graphs.

**Chapter Headings:**

PART I: MEASUREMENT AND GRAPHIN

1. Introduction to Measurement
2. Length and the Number Line
3. Practical Arithmetic
4. Relations, Functions and Graphing
5. The Linear Function

PART II: GRAPHING, EQUATIONS AND LINEAR FUNCTIONS

1. Relations, Functions and Graphing
2. Open Sentences and Equations
3. A Gas Law and Linear Functions
4. An Experimental Approach to Linear Functions

PART III: AN EXPERIMENTAL APPROACH TO FUNCTIONS

1. Introduction to Graphing
2. An Experimental Approach to Linear Functions
3. An Experimental Approach to Quadratic Functions
4. The Lens and Floating Magnet Functions

# THE SMSG PROGRAMED LEARNING PROJECT

In 1961, the SMSG Advisory Board decided that a careful study of programed learning should be undertaken with special reference to SMSG materials. The material chosen was the SMSG *First Course in Algebra*, written in 1958-60 and tried widely in the schools. It was felt that although programed instruction had evolved as a psychologist's tool, the SMSG efforts should be carried out jointly by mathematicians, teachers of mathematics, and psychologists under the supervision of a Panel on Programed Learning whose members include: R. C. Buck, University of Wisconsin; E. E. Hammond, Jr., Phillips Academy, Andover; L. D. Hawkinson, San Francisco Public Schools; J. G. Holland, Harvard; W. J. McKeachie, University of Michigan, H. M. MacNeille, Case Institute of Technology; H. O. Pollak, Bell Telephone Laboratories; and D. W. Taylor, Yale.

During the summer of 1961, a workshop was held in New Haven, Connecticut, to acquaint a group of authors, already familiar with the SMSG *Algebra*, with the techniques of programed instruction. Two formats evolved: (1) Constructed Response, based on the Skinnerian point of view that a program should have small steps, require active response, and elicit relatively error-free performance in acquiring new information; (2) Multiple Choice, a scrambled text based on the work of N. Crowder, with incorrectly chosen alternatives giving explanation of sources of error. Six small writing teams were found throughout the country to translate the SMSG *First Course in Algebra* into a constructed response format; six others were found to write a multiple choice format; both of these worked on a part-time basis during the 1961-62 academic year with their work reviewed by a team of mathematicians, teachers, and psychologists.

In the summer of 1962, at an SMSG Writing Session at Stanford, each of the two experimental versions was revised by a team of writers. To complement their work, a set of chapter tests and both pretests and posttests were written. These materials were tried out during 1962-63 in a wide variety of experimental situations including classes where the programed text was used, self-paced, by students with little assistance from teachers, classes where the programed text was used on a timed (per section) basis with teachers playing a more active role, and by classes where the programed text was used in conventional classroom as a text replacement. Control classes were established using the SMSG *First Course in Algebra* (Yale Text). Three programed versions (Form CR, Form MC, and a machine format of Form CR) were thus compared with the text (9F).

Confirming many other small experiments (few have attempted to program a whole course), little difference between forms was found in performance on pretesting, posttesting, and chapter tests. Further, teachers reported high boredom on the part of most experimental students. But, many of the students using the programed materials completed more of the course than control classes using the 9F text.

The reactions of teachers and students were surveyed carefully during the spring of 1963. Index, review sections, more practice sets, no scrambling of the text, and some straight text materials were called for.

Thus, during the summer of 1963, a new programed text was prepared which attempted to draw the features of the earlier two versions together and to include those features which teachers had called for. The new *Programed First Course in Algebra* (Form H) turned out to be a less voluminous set of books than either of the earlier programed texts (1000 pp. in H, as opposed to 1700 in CR and 2400 in MC). More significantly, the new format which is being tried in 1963-64 on an experimental basis is achieving better results than either of the preliminary formats and is reported as being teachable as a classroom text or as a self-instruction text for students who are absent for extended periods or who are moved into SMSG classes from conventional classes.

With the teacher and student reactions from the 1963-64 classes, the 1964 summer writing-team will revise Form H for extended classroom use in 1964-65. The revised version for fall, unlike the preliminary version, will be accompanied by a separate response book to make it possible for schools to reuse the programed text by replenishing their supply of student response books.

The 1963 Preliminary Edition of SMSG *Programed First Course in Algebra* (Form H) remains almost a section-by-section translation of the SMSG *First Course in Algebra*. It is thus possible to move students in and out of the programed text when used in a class where the SMSG text is taught. The 1964 Revised Edition of SMSG *Programed First Course in Algebra* (Form H) may contain some new material which has evolved since the 9F text was first written, but will remain basically the same course.

If you are not now on our mailing list but wish to receive further issues of this NEWSLETTER, please request, by means of a post card, that your name be added to the mailing list.

SCHOOL
MATHEMATICS
STUDY GROUP

# Newsletter No. 20

*April 1965*

## SMSG PUBLICATIONS

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E. G. Begle

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# CONTENTS

NEW PUBLICATIONS, 5

- CALCULUS, 5
- SPANISH TRANSLATIONS, 5
- NEW MATHEMATICAL LIBRARY, 5
- SUPPLEMENTARY MATERIALS, 5
- SUPPLEMENTARY AND ENRICHMENT SERIES, 6
- STUDY GUIDES, 6
- TEACHER TRAINING COURSE, 6
- CONFERENCE REPORT, 6
- MISCELLANEOUS PUBLICATIONS, 6

HOW TO OBTAIN SMSG PUBLICATIONS, 7

NEWSLETTERS, 7

HIGH SCHOOL TEXTS, 8

JUNIOR HIGH SCHOOL TEXTS, 8

ELEMENTARY SCHOOL TEXTS, 8

TEXTS FOR SLOWER STUDENTS, 9

PROGRAMED ALGEBRA TEXT, 9

NEW MATHEMATICAL LIBRARY, 9

SUPPLEMENTARY MATERIALS, 10

SUPPLEMENTARY AND ENRICHMENT SERIES, 10

SPANISH TRANSLATIONS, 11

STUDIES IN MATHEMATICS, 11

STUDY GUIDE IN MATHEMATICS, 11

FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS, 12

CONFERENCE REPORTS, 12

MISCELLANEOUS PUBLICATIONS, 13

ORDER FORMS, 15

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## EW PUBLICATIONS

The following SMSG publications have appeared ince the last SMSG Publications Newsletter No. 18 as issued. For information on obtaining any of these e the listings which follow.

1. **Calculus.** A calculus text is being prepared for se in high school by students who have gone through he equivalent of the SMSG text "Intermediate Mathe- atics." The first half of the preliminary version of he student text is available for inspection. The text ill be revised during the summer of 1965. The re- ised version, together with a Teacher's Commentary ill be available for general use as of September 1, 965.

2. **Spanish Translations.** The following additional anslations into Spanish of SMSG texts and commen- aries are now available:

Matematicas Para El Primer Ciclo Secundario,
2 Parts, Comentario (CJI-RS)
Matematicas Para El Primer Ciclo Secundario,
2 Parts, Comentario (CJII-RS)
Matematicas Para La Escuela Secundaria, Primer
Curso de Algebra, 2 Parts, Comentario (CF-RS)
Matematicas Para La Escuela Secundaria,
Geometria, 2 Parts, Comentario (CG-RS)
Matematicas Para La Escuela Secundaria,
Matematica Intermedia, 2 Parts (I-RS)

3. **New Mathematical Library.** Two new mono- raphs are now available:

Episodes From Early Mathematics, by Asger Aaboe
Groups and Their Graphs, by Grossman and Magnus

4. **Supplementary Materials.** A unit entitled Mathematics and Living Things" has been prepared preliminary form. It is designed for use at the ighth grade level and it uses biological experiments to otivate mathematical ideas. A preliminary version is ow available for inspection. A revised version will be repared during the summer of 1965 and will be made vailable for general use as of September 1, 1965.

Revised versions of Mathematics Through Science, arts 1, 2, and 3, are now available. Parts 1 and 2 are tended for use in any seventh and eighth grade course. art 3 is explicitly designed for ninth grade general athematics courses.

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5. **Supplementary and Enrichment Series.** Te new pamphlets, including teacher's commentaries, ar now available with the following titles:

| | |
|---|---|
| SP-14 | Numeration |
| SP-16 | Algebraic Structures |
| SP-17 | Factors and Primes |
| SP-19 | Mathematical Systems |
| SP-21 | Systems of First Degree Equations in Three Variables |
| SP-23 | Radioactive Decay |

6. **Study Guides.** A study guide on computing i available. It consists essentially of an annotated bibliography intended for teachers interested in the topi of high speed computation as it might appear in th high school program. This study guide is now automatically included among the other study guides i algebra, calculus, geometry, number theory, probabilit and statistics.

7. **Teacher Training Course.** Most of the SMS materials for teachers are designed to provide a soun mathematical background for any course, conventiona or new, at a specific level. Much in-service training o teachers is now done by local school systems and quit often there is not enough time for such general preparation. In-service courses are needed which will prepar teachers to teach a specific new course. In order t illustrate what such a course might look like SMSG i preparing a fifteen lesson course designed to prepar teachers to teach the SMSG seventh grade course.

The preliminary version of the text for in-servic teachers is now available for inspection. A revise version, with a Teachers' Commentary, will be availabl as of September 1, 1965.

8. **Conference Report.** In April of 1964 SMS sponsored a conference with financial support from th Office of Education on below average achievers in mathematics. The purpose of the conference was twofold First, the participants were briefed on the psychologica and sociological problems that would have to be face in any attempt to prepare mathematics programs fo below average achievers. Second, the conference gav the participants a chance to make recommendations a to activities which SMSG and other organization might take in this general area.

9. **Miscelleaneous Publication.** The very size o SMSG and the great number of individuals who hav participated in various SMSG activities preclude an possibility of a detailed and, at the same time, widel agreed on philosophy with respect to the school mathematics program. Nevertheless, each of the SMSG writ

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ng teams did evolve a philosophy with respect to its part of the curriculum. These philosophies are implicit in the texts prepared by the writing teams. Nevertheless, it seemed worthwhile to ask for more xplicit statements of these philosophies.

At the same time as the statements were prepared brief account of the specific procedures used by the writing team was also prepared.

These statements are now made available in a pub-ication entitled Philosophies and Procedures of SMSG Writing Teams.

## HOW TO OBTAIN SMSG PUBLICATIONS

There are two main distributors for SMSG materials. Most of the texts are distributed by the Yale Univer-ity Press. In the following listings, these are preceded by the symbol Y. An order blank appears on pages 7 and 18.

Most of the other publications are distributed by A. C. Vroman, Inc. In the listings which follow, these are preceded by the symbol V. Order blanks appear on pages 19, 20, 21, 23 and 25.

A few of the publications will be available from Vroman's until June 30, 1965, after which time they will be available only from the Yale University Press. n the following listings these are identified by the ymbol VY.

Instructions for ordering other SMSG publications will be found in the listings below.

NOTE: The materials distributed by the Yale Uni-ersity Press and by A. C. Vroman, Inc. are priced at ssentially the cost of printing and distribution. Free nspection or desk copies are not possible, and dis-ounts for quantity orders, other than those indicated on the order blanks, cannot be given.

## NEWSLETTERS

In order to keep the mathematical community in-ormed, an SMSG Newsletter is published from time o time. A postcard request is sufficient for one to be laced on the mailing list.

The following issues are still available in limited uantities from: SMSG — Cedar Hall, Stanford Uni-ersity, Stanford, California 94305

Newsletter No. 10 — Reports on Student Achievement in SMSG Courses
Newsletter No. 14 — The New Mathematical Library
Newsletter No. 15 — Reports
Newsletter No. 17 — Panel on Supplementary Publications
Newsletter No. 19 — Report of a Survey of In-Service Programs for Mathematics Teachers

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## HIGH SCHOOL TEXTS

These texts are designed for average and abov
average students in a college preparatory progra
*Geometry with Coordinates* is designed as an alterna
tive to *Geometry* putting more emphasis on analyti
geometry. *Matrix Algebra* and *Analytic Geometry* ar
intended for students who have completed the prereq
uisites for calculus but wish to postpone study of th
subject until college.

Each text is accompanied by an extensive teacher
commentary.

| | |
|---|---|
| First Course in Algebra | Y |
| Geometry | Y |
| Geometry with Coordinates | Y |
| Intermediate Mathematics | Y |
| Elementary Functions | Y |
| Introduction to Matrix Algebra | Y |
| Analytic Geometry | VY |
| Calculus | V |

## JUNIOR HIGH SCHOOL TEXTS

These texts review and extend the mathematics o
the elementary school in such a way as to provide
sound intuitive foundation for high school courses.
considerable amount of informal geometry is include

Each text is accompanied by an extensive teacher
commentary.

Mathematics for Junior High School, Volume I
Mathematics for Junior High School, Volume II

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4-6 presuppose a conventiona
program through grade 3. The emphasis in all thes
texts is similar to that of the Junior High School text

In the Teacher's Commentary for each text all page
of the student text are reproduced. For Kindergarte
there is only a teacher's book.

| | |
|---|---|
| Mathematics for the Elementary School, Book K (Teacher's Commentary only) | VY |
| Mathematics for the Elementary School, Book 1 | VY |
| Mathematics for the Elementary School, Book 2 | VY |
| Mathematics for the Elementary School, Book 3 | VY |
| Mathematics for the Elementary School, Grade 4 | Y |
| Mathematics for the Elementary School, Grade 5 | Y |
| Mathematics for the Elementary School, Grade 6 | Y |

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## EXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in he texts for grades 7-9 listed above. However, the evel of reading difficulty has been reduced to make hem more suitable for students who are slightly beow average in ability. It is expected that such stuents will proceed through these materials at a reduced ate.

Each text is accompanied by an extensive teacher's ommentary.

| | |
|---|---|
| Introduction to Secondary School Mathematics, Volume I | Y |
| Introduction to Secondary School Mathematics, Volume II | Y |
| Introduction to Algebra | Y |

## ROGRAMED ALGEBRA TEXT

The text "First Course in Algebra" was redone in rogramed form for experimental purposes, but is ow available for general use. The student uses a eparate response booklet, so the text is reusable.

There is a brief teacher's commentary.

| | |
|---|---|
| Programed First Course in Algebra | VY |

## EW MATHEMATICAL LIBRARY

This consists of a series of short expository monoraphs on various mathematical subjects. The obectives of this series are the dissemination of good athematics in the form of elementary topics not usully covered in the school curriculum, the awakening of nterest among gifted students, and the presentation of athematics as a meaningful human activity.

The authors of these monographs are mathematiians interested and well versed in the fields they treat.

A trade edition of these monographs is available hrough Random House. In addition, a special edition available only to high school students and teachers t a reduced rate from the L. W. Singer Co. An order orm appears on page 29.

Numbers Rational and Irrational by Ivan Niven
What is Calculus About? by W. W. Sawyer
An Introduction to Inequalities by Beckenbach and Bellman
Geometric Inequalities by Nicholas D. Kazarinoff
The Contest Problem Book by Charles T. Salkind
The Lore of Large Numbers by Philip J. Davis
Uses of Infinity by Leo Zippin
Geometric Transformations by I. M. Yaglom
Continued Fractions by C. D. Olds

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Graphs and Their Uses by Oystein Ore
Hungarian Problem Book I
translated by E. Rapaport
Hungarian Problem Book II
translated by E. Rapaport
Episodes From Early Mathematics by Asger Aaboe
Groups and Their Graphs by Grossman and Magnu

## SUPPLEMENTARY MATERIALS

A variety of booklets are available. Their commo characteristic is that each requires less than a ful academic year.

| | |
|---|---|
| Mathematics Through Science, Part I | V |
| Mathematics Through Science, Part II | V |
| Mathematics Through Science, Part III | V |
| Junior High School Mathematics Units, Number Systems | V |
| Junior High School Mathematics Units, Geometry | V |
| Junior High School Mathematics Units, Applications | V |
| Junior High School Supplementary Unit | V |
| Essays on Number Theory I | V |
| Essays on Number Theory II | V |
| Development of the Real Number System | V |
| Selected Units, Grade 4 (E-4150) | V |
| Mathematics and Living Things | V |

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets are designed to allo teachers to try short modern treatments of (particular) mathematics topics in class. Some, however, are de- signed for independent study or enrichment. Teacher' commentaries are available for some of these.

| | |
|---|---|
| Functions | V |
| Circular Functions | V |
| The Complex Number System | V |
| The System of Vectors | V |
| Non-Metric Geometry | V |
| Plane Coordinate Geometry | V |
| Inequalities | V |
| Numeration | V |
| Algebraic Structures | V |
| Factors and Primes | V |
| Mathematical Systems | V |
| Systems of First Degree Equations in Three Variables | V |
| Radioactive Decay | V |

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## SPANISH TRANSLATIONS

Some of the texts listed above have been translated into Spanish for use in Puerto Rico. Translations of the teachers' commentaries are also available.

| | |
|---|---|
| Matematicas Para El Primer Ciclo Secundario, Volumen I | V |
| Matematicas Para El Primer Ciclo Secundario, Volumen II | V |
| Matematica Para La Escuela Secundaria, Primer Curso de Algebra | V |
| Matematica Para La Escuela Secundaria, Geometria | V |
| Matematica Para La Escuela Secundaria, Matematica Intermedia | V |

## STUDIES IN MATHEMATICS

The books in this series are all intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

| | |
|---|---|
| Euclidean Geometry Based on Ruler and Protractor Axioms | V |
| Structure of Elementary Algebra | V |
| Geometry | V |
| Concepts of Informal Geometry | V |
| Number Systems | V |
| Intuitive Geometry | V |
| Concepts of Algebra | V |
| Brief Course in Math for Elementary School Teachers | V |
| Applied Mathematics in the High School | V |
| Mathematical Methods in Science | V |

## STUDY GUIDES IN MATHEMATICS

These consist of annotated bibliographies on various parts of mathematics, all bound in one pamphlet. They are intended for teachers wishing to study by themselves and also for those planning courses for teachers.

| | |
|---|---|
| Study Guides in Mathematics (Algebra, Calculus, Geometry, Number Theory, Probability and Statistics, Digital Computing and Related Mathematics) | V |

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## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

This course consists of thirty half-hour color films The series is intended primarily for in-service elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementar school mathematics programs. The series is mathematical in content but no mathematical prerequisite are presumed. Studies in Mathematics, Vol. 9, is designed to accompany this filmed course.

The first sixteen of these films provide a suitabl background in mathematics for teachers of grade K-3. The remainder, building on these, are concerne with mathematics normally taught in grades 4-6.

The distributor for these films is Modern Learnin Aids, 3 East 54th Street, New York 22, New York Distribution will be from the following five locations 160 E. Grand Avenue, Chicago, Illinois 60611; 141 Slocum Street, Dallas, Texas 75207; 714 Spring Street N.W., Atlanta, Georgia 30308; 444 Market Street, Sa Francisco, California 94105; and 315 Springfield Avenue, Summit, New Jersey 07901.

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were hel to acquaint teachers with the contents and objective of SMSG texts. Others were devoted to discussions o problems in mathematics education and the role o SMSG in attacking these problems.

Elementary School Mathematics .................................. V

Orientation Conference for
SMSG Experimental Centers .................................. V

Orientation Conference for SMSG
Elementary School Experimental Centers ......... V

Orientation Conference for
Geometry with Coordinates .................................. V

Future Responsibilities for School Mathematics V

Mathematics Education for
Below Average Achievers .................................. V

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## MISCELLANEOUS PUBLICATIONS

Very Short Course in Math for Parents ........................ V

This booklet is designed to give parents (and other interested persons) a chance to work through a small sample of "modern" mathematics and thus to see more clearly how and in what ways the "modern" treatment differs from the traditional.

Philosophies and Procedures of SMSG Writing Teams, see page 21 ........................ V

ORDER FORMS

ON

FOLLOWING PAGES

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## ORDER INFORMATION

1. The Student's Text and the Teacher's Commentary must be listed separately on your order. The two parts of each set, however, cannot be ordered separately.
2. Orders will not be acknowledged unless specifically requested and an acknowledgment form is provided.
3. An educational discount of 30% will be given to schools; a courtesy discount of 10% will be given to libraries, teachers, and other persons directly associated with the field of mathematics.
4. All regular shipping charges by book post or by truck will be paid by Yale University Press. If you request any special shipping services (airmail, special delivery, etc.) the extra charges will be billed on your invoice.
5. We regret that we cannot supply free desk or examination copies.
6. As it takes longer to process an order during the rush period in July and August, we urgently suggest that you place your orde well in advance of your needs. Orders for the new SMSG-Yal publications will be shipped on a first come, first served basi starting as soon as the books are available on July 1, 1965.

   Orders listing only Grade 7—12 texts and commentaries currently available will be processed as they are received unless a specific shipping date is requested.
7. Invoices will be sent when the books are shipped unless it i specifically requested that they be sent at a different time.
8. Returns may be made without prior permission, subject to th following conditions:
   - All returns must be sent back in salable condition, shippin charges prepaid.
   - Books must be returned to the shipping center indicated o the invoice, **not** to Yale University Press, New Haven.
   - Credit will be issued **only** for sets of books. We cannot accep parts of sets.
   - Our SMSG invoice number or numbers covering the purchas must accompany the shipment, preferably in an envelope attached to the outside of the parcel. (Your charge-back mem or other documents should be in the same envelope.)
9. All correspondence concerning orders should be addressed to

Yale University Press
School Mathematics Study Group
92A Yale Station
New Haven, Connecticut

## ORDER FORM

Yale University Press
School Mathematics Study Group
92A Yale Station
New Haven, Connecticut

| Quantity | | Cost | Total |
|---|---|---|---|
| | **MATHEMATICS FOR THE ELEMENTARY SCHOOL** | | |
| | Book K, Teacher's Commentary | $1.50 | |
| | Book 1, Textbook | $1.50 | |
| | Book 1, Teacher's Commentary, Parts I and II | $3.00 | |
| | Book 2, Textbook | $1.50 | |
| | Book 2, Teacher's Commentary, Parts I and II | $3.00 | |
| | Book 3, Textbook, Parts I and II | $3.00 | |
| | Book 3, Teacher's Commentary, Parts I and II | $3.00 | |
| | Grade 4, Student's Text Parts I and II, per set | $3.00 | |
| | Grade 4, Teacher's Commentary, Parts I and II, per set | $3.00 | |
| | Grade 5, Student's Text, Parts I and II, per set | $3.00 | |
| | Grade 5, Teacher's Commentary, Parts I and II, per set | $3.00 | |
| | Grade 6, Student's Text, Parts I and II, per set | $3.00 | |
| | Grade 6, Teacher's Commentary, Parts I and II, per set | $3.00 | |
| | **INTRODUCTION TO SECONDARY SCHOOL MATHEMATICS** | | |
| | Volume 1, Student's Text, Parts I and II, per set | $3.00 | |
| | Volume 1, Teacher's Commentary, per copy | $3.00 | |
| | Volume 2, Student's Text, Parts I and II, per set | $3.00 | |
| | Volume 2, Teacher's Commentary, per copy | $3.00 | |
| | **INTRODUCTION TO ALGEBRA** | | |
| | Student's Text, Parts I and II, per set | $3.00 | |
| | Teacher's Commentary, Parts I and II, per set | $3.00 | |
| | **GEOMETRY WITH COORDINATES** | | |
| | Student's Text, Parts I and II, per set | $3.00 | |
| | Teacher's Commentary, Parts I and II, per set | $3.00 | |

**MATHEMATICS FOR JUNIOR HIGH SCHOOL**

| | | | |
|---|---|---|---|
| | Volume 1, Student's Text, Parts I and II, per set | $3.00 | |
| | Volume 1, Teacher's Commentary, Parts I and II, per set | $3.00 | |
| | Volume 2, Student's Text, Parts I and II, per set | $3.00 | |
| | Volume 2, Teacher's Commentary, Parts I and II, per set | $3.00 | |

**FIRST COURSE IN ALGEBRA**

| | | | |
|---|---|---|---|
| | Student's Text, Parts I and II, per set | $3.00 | |
| | Teacher's Commentary, Parts I and II, per set | $3.00 | |

**GEOMETRY**

| | | | |
|---|---|---|---|
| | Student's Text, Parts I and II, per set | $3.00 | |
| | Teacher's Commentary, Parts I and II, per set | $3.00 | |

**INTERMEDIATE MATHEMATICS**

| | | | |
|---|---|---|---|
| | Student's Text, Parts I and II, per set | $3.00 | |
| | Teacher's Commentary, Parts I and II, per set | $3.00 | |

**ELEMENTARY FUNCTIONS**

| | | | |
|---|---|---|---|
| | Student's Text, per copy | $2.00 | |
| | Teacher's Commentary, per copy | $2.00 | |

**INTRODUCTION TO MATRIX ALGEBRA**

| | | | |
|---|---|---|---|
| | Student's Text, per copy | $2.00 | |
| | Teacher's Commentary, per copy | $2.00 | |

**PROGRAMED FIRST COURSE IN ALGEBRA (Form H)**

| | | | |
|---|---|---|---|
| | 2 Volumes, Textbook | $5.00 | |
| | Response Booklet | $1.50 | |
| | Teacher's Commentary | $1.50 | |

**ANALYTIC GEOMETRY**

| | | | |
|---|---|---|---|
| | Textbook, Parts I and II | $3.00 | |
| | Teacher's Commentary, Parts I and II | $3.00 | |

Bill to:

Ship to:

## SMSG ORDER FORM

## PUBLICATIONS

A. C. Vroman, Inc.
367 South Pasadena Ave.
Pasadena, California

**STUDIES IN MATHEMATICS**

| Quantity | | Cost | Total |
|---|---|---|---|
| | Euclidean Geometry Based on Ruler and Protractor Axioms (SM-2) | $ .90 | |
| | Structure of Elementary Algebra (SM-3) | $1.40 | |
| | Geometry (SM-4) | $2.75 | |
| | Concepts of Informal Geometry (SM-5) | $1.45 | |
| | Number Systems (SM-6) | $2.40 | |
| | Intuitive Geometry (SM-7) | $1.25 | |
| | Concepts of Algebra (SM-8) | $2.40 | |
| | Brief Course in Mathematics for Elementary School Teachers (SM-9) | $2.00 | |
| | Applied Mathematics in the High School (SM-10) | $ .75 | |
| | Mathematical Methods in Science (SM-11) | $1.00 | |

**CONFERENCE REPORTS**

| | | | |
|---|---|---|---|
| | Conference on Elementary School Mathematics (CR-1) | $ .40 | |
| | Orientation Conference for SMSG Experimental Centers (CR-2) | $1.00 | |
| | Orientation Conference for SMSG Elementary School Experimental Centers (CR-3) | $1.00 | |
| | Orientation Conference for Geometry with Coordinates (CR-4) | $ .40 | |
| | Conference on Future Responsibilities for School Mathematics (CR-5) | $ .25 | |
| | Mathematics Education for Below Average Achievers (CR-6) | $ .50 | |

**STUDY GUIDES IN MATHEMATICS** (Volume includes Algebra, Calculus, Digital Computing and Related Mathematics, Geometry, Number Theory, Probability and Statistics)

| | | | |
|---|---|---|---|
| | 1 to 4 copies, each | $ .50 | |
| | 5 or more copies, each | $ .35 | |

## JUNIOR HIGH SCHOOL MATHEMATICS UNITS

| | | | |
|---|---|---|---|
| ______ | Number Systems, text (U-1) | $ .70 | ______ |
| ______ | Number Systems, commentary (CU-1) | $ .70 | ______ |
| ______ | Geometry, text (U-2) | $ .60 | ______ |
| ______ | Geometry, commentary (CU-2) | $ .60 | ______ |
| ______ | Applications, text (U-3) | $ .40 | ______ |
| ______ | Applications, commentary (CU-3) | $ .40 | ______ |
| ______ | Complete Set (one of each of the six above) | $2.95 | ______ |

## SUPPLEMENTARY UNITS

| | | | |
|---|---|---|---|
| ______ | Junior High School Supplementary Unit, text (JSU) | $ .80 | ______ |
| ______ | Junior High School Supplementary Unit, commentary (CJSU) | $ .65 | ______ |
| ______ | Essays on Number Theory, I (HSU-1 | $ .30 | ______ |
| ______ | Essays on Number Theory, II (HSU-2) | $ .50 | ______ |
| ______ | Development of the Real Number System (HSU-3) | $ .90 | ______ |
| ______ | Selected Units, Grade 4 (E-4150) | $ .75 | ______ |

## MATHEMATICS THROUGH SCIENCE

| | | | |
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239 Great Neck Road
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Long Island, New York

A hard bound library edition is distributed by Library Publishers, Inc. Each volume in this edition is priced at $2.95, and can be ordered from:

Library Publishers, Inc.
153 North Michigan Avenue
Chicago 1, Illinois

A reduced price edition is available from L. W. Singer Company, **but only to elementary and secondary schools.** Each volume in this paper bound edition is priced at $.90. An order form for school use is on the opposite page.

**SCHOOL**
**MATHEMATICS**
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# Newsletter No. 21

*May 1965*

*Reference Guide to*
*The New Mathematical Library*
*Description, Topical Classification,*
*and Index with Suggested*
*Grade Levels.*

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# CONTENTS

MONOGRAPH PANEL, 2

MONOGRAPH PROJECT, 4

- OBJECTIVES AND ORGANIZATION, 4
- BOOKS PUBLISHED TO DATE, 4
- SUGGESTIONS TO TEACHERS ON THE USE OF NML BOOKS, 5
- REFERENCE GUIDE, 6

I

DESCRIPTION OF NML BOOKS WITH SUGGESTED GRADE LEVELS, 7

- NUMBERS: RATIONAL AND IRRATIONAL, 7
- WHAT IS CALCULUS ABOUT?, 8
- AN INTRODUCTION TO INEQUALITIES, 9
- GEOMETRIC INEQUALITIES, 10
- THE CONTEST PROBLEM BOOK, 10
- THE LORE OF LARGE NUMBERS, 11
- USES OF INFINITY, 11
- GEOMETRIC TRANSFORMATIONS, 12
- CONTINUED FRACTIONS, 13
- GRAPHS AND THEIR USES, 15
- HUNGARIAN PROBLEM BOOK I, II, 16
- EPISODES FROM THE EARLY HISTORY OF MATHEMATICS, 17
- GROUPS AND THEIR GRAPHS, 18
- THE MATHEMATICS OF CHOICE, 20
- FROM PYTHAGORAS TO EINSTEIN, 21

II

TOPICS IN NML BOOKS SUGGESTED FOR EACH GRADE LEVEL, 23

- GRADE 9, 23
- GRADE 10, 24
- GRADE 11, 25
- GRADE 12, 27

INFORMATION ON ORDERING, 30

SMSG ORDER FORM, 31

SCHOOL MATHEMATICS STUDY GROUP
MONOGRAPH PROJECT

## OBJECTIVES AND ORGANIZATION

The Monograph Project was formed in 1958 in order to make available to high school students a number of short expository books on various mathematical topics not usually covered in the high school syllabus. This series of monographs, known as the *New Mathematical Library* has as its main aims the dissemination of good mathematics; the awakening of interest among gifted students; the presentation of mathematics as a meaningful human activity. The authors of NML books are mathematicians well versed in the fields they treat. The Editorial Panel consists of mathematicians and teachers concerned with the readability and clarity of NML books from the point of view of a high school student who may wish to study them on his own. In processing manuscripts, the Editorial Panel invites comments by teachers and often also by students; these are then conveyed to the authors so that they may be taken into account in revisions of manuscripts.

The headquarters of the Monograph Project are at New York University, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012. The members of its Editorial Panel are appointed by the Director of SMSG and serve on the panel for approximately three years.

## BOOKS PUBLISHED TO DATE*

1. *Numbers: Rational and Irrational* by I. Niven
2. *What Is Calculus About?* by W. W. Sawyer
3. *An Introduction to Inequalities* by E. Beckenbach and R. Bellman
4. *Geometric Inequalities* by N. D. Kazarinoff
5. *The Contest Problem Book:* Annual High School Contests 1950-1960 of the MAA, compiled and with solutions by C. T. Salkind
6. *The Lore of Large Numbers* by P. J. Davis
7. *Uses of Infinity* by L. Zippin
8. *Geometric Transformations* by I. M. Yaglom, translated from the Russian by A. Shields
9. *Continued Fractions* by C. D. Olds
10. *Graphs and Their Uses* by O. Ore
11. *Hungarian Problem Book I*, based on the Eötvös Competitions, 1894-1905
12. *Hungarian Problem Book II*, based on the Eötvös Competitions, 1906-1928

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* For information on ordering, see pp. 30 and 31.

13. *Episodes from the Early History of Mathematics* by A. Aaboe
14. *Groups and Their Graphs* by I. Grossman and W. Magnus
15. *Mathematics of Choice (How to Count Without Counting)* by I. Niven
16. ***From Pythagoras to Einstein* by K. O. Friedrichs

Additional titles are in preparation and will appear after 1965.

## SUGGESTIONS TO TEACHERS ON THE USE OF NML BOOKS

The NML books are not textbooks. However, a mathematics teacher might use them in the following ways: If a student expresses interest in a topic touched on in class and more fully developed in one of the NML books, his teacher might tell him to study the relevant chapters in this book. If a large number of students express such an interest, a whole chapter from one of these books might be studied in class. Gifted students who seem to be ahead of their classmates could be told to work through one or another of the NML books independently.

It is difficult to say exactly what preparation is required on the part of a reader of a given NML book, but the following descriptions may serve as a guide. It should be kept in mind, however, that, even if little knowledge is necessary, quite a bit of mathematical maturity and sophistication may be needed in some instances.

It is important that students be aware of the nature of a mathematical book; i.e., that they do not expect to read it as they would read a novel, that they do not get discouraged if they get stuck, that they learn to come back to difficult points later in their careers.

The editors have tried to persuade the authors to begin each NML book in a leisurely way and to let the level of difficulty increase gradually. The books vary considerably not only in content, but in manner of exposition, in style, and in degree of sophistication. Readers of varying tastes and talents are likely to profit by studying some of these monographs, even if they cannot come to grips with all of them.

The editors gratefully acknowledge the work of Mr. B. Bold in preparing the material in the following pages. They urge all teachers to examine the NML

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** To appear late in 1965

books and to recommend to some of their students, perhaps with the aid of this Guide, the books most appropriate in a given situation. We also suggest that teachers tell school librarians and bookstores about the New Mathematical Library so that the books become available to interested students even if they are not purchased in large quantities by the school. NDEA funds may be used to purchase the NML books.

## REFERENCE GUIDE

This guide is divided into two parts:

**I Description of *NML* Books with Suggested Grade Levels,**

**II Topics in *NML* Books Suggested for Each Grade Level.**

The first part of the guide consists of a brief description of each volume followed by a chapter by chapter listing of its contents. The grade level at which the topics of a chapter may be appropriately studied appears next to each chapter. This assignment of grade level to each chapter must, of course, be interpreted as a mere suggestion, since the best time for a student to study a particular topic depends on the curriculum sequence of the school and the abilities of the student. For instance, the numbers 9 and 11 (instead of 9, 10, 11) may appear next to a topic from algebra merely because most schools devote the tenth year almost exclusively to geometry. Moreover, these numbers should be interpreted as lower bounds; a topic considered appropriate for tenth grade may be even more appropriate for the eleventh and twelfth.

The second part of the guide is separated into four sections: material suitable for ninth grade, tenth grade, eleventh grade, and twelfth grade. In each section, portions of NML books are classified according to mathematical subjects such as inequalities, polynomials, number theory, etc., and every topic is followed by the numbers of volumes and chapters where a discussion can be found. Such a topical index is never perfect (even if meticulously cross-referenced) since mathematical subjects overlap and do not allow themselves to be so neatly pigeonholed.

The references to problems from volumes 11 and 12 need a special word of explanation. A reference of the type 12, 1907/2 means *NML* volume 12, contest year 1907, Problem 2, and agrees precisely with the notation used in volumes 11 and 12; so these problems are easily located. If a particular problem is listed under, say, number theory, then either the problem, or its solution, or an explanatory note supplementing the solution has connections with number theory. The listing of a problem in the ninth grade section does *not* necessarily mean that ninth graders are expected to solve it; instead, it means that the problem and, usually, its solution employ concepts often developed by the end of the ninth school year. In other words, these problems serve to stimulate, teach and enrich rather than test the student. Problems from *NML* volume 5, which has its own classification, are not indexed in this guide.

We hope that these indices will be helpful in spite of their weaknesses.

# I

## DESCRIPTION OF NML BOOKS WITH SUGGESTED GRADE LEVELS

### NML 1

### NUMBERS: RATIONAL AND IRRATIONAL

by IVAN NIVEN

This book deals with the number system, one of the basic structures in mathematics. Professor Niven starts with the natural numbers and goes on to define and discuss their extension to the rationals and to the real numbers. His clear proofs of the characteristic properties of certain classes of numbers and his remarks on the nature of proof can be read with profit by good students in the ninth grade. Later chapters in the book require considerably more background and maturity.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Natural Numbers and Integers**<br>Primes and factors<br>Closure | 9 |
| 2 | **Rational Numbers**<br>Periodic decimals | 9 and 11 |
| 3 | **Real Numbers**<br>Real number line<br>Decimal representations of real numbers<br>Proof of irrationality of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{2} + \sqrt{3}$, etc.<br>Application to geometric theorem (three parallel lines divide any two segments proportionally — incommensurable case) | 9, 10 and 11 |
| 4 | **Irrational Numbers**<br>Construction of irrational numbers<br>Rational roots of polynomial equations<br>Classes of irrational algebraic numbers | 11 and 12 |

| | | |
|---|---|---|
| 5 | **Trigonometric and Logarithmic Numbers**<br>Algebraic and transcendental numbers<br>Applications to constructions with straight edge and compasses (doubling the cube, trisecting an angle, squaring the circle) | 11 and 12 |
| 6 | **Approximation of Irrationals by Rationals**<br>Inequalities<br>The "best" approximations | 12 |
| 7 | **The Existence of Transcendental Numbers**<br>Liouville's construction of a transcendental number | 12 |
| Appendix A | **Proof That There Are Infinitely Many Prime Numbers (Euclid)** | 9 |
| Appendix B | **Proof of the Fundamental Theorem of Arithmetic**<br>Unique factorization | 9 |
| Appendix C | **Cantor's Proof of the Existence of Transcendental Numbers**<br>Cantor's "diagonal" method | 12 |

## NML 2

### WHAT IS CALCULUS ABOUT?

by W. W. SAWYER

Although the word "calculus" appears in the title of this book, the only background required is a familiarity with easy algebraic manipulations and the ability to understand the graphing of simple functions. The author develops the basic concepts of the calculus (derivative, integral) intuitively, exploiting such familiar concepts as speed, acceleration, volume; but he includes a chapter on the need for rigor.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **What Must You Know to Learn Calculus?**<br>Importance of calculus<br>Mastering a mathematical result | 9 |
| 2 | **The Study of Speed**<br>Calculating velocity<br>Graphical representation of velocity<br>Rates of change | 9 |
| 3 | **The Simplest Case of Varying Speed**<br>Instantaneous velocity<br>Velocity when motion is described by $s = t^2$<br>Procedure for determining velocity | 9 |

| | | |
|---|---|---|
| 4 | **The Higher Powers**<br>Determination of instantaneous velocity when motion is described by $s = t^n$ | 9 |
| 5 | **Extending Our Results**<br>Rate of growth of polynomials | 9 |
| 6 | **Calculus and Graphs**<br>Finding slope of a curve at a point<br>Using calculus to graph an equation<br>Graphs with discontinuities<br>Extreme values (maxima and minima) | 9 |
| 7 | **Acceleration and Curvature** | 9 |
| 8 | **The Reverse Problem**<br>Find the Rate of Change,<br>Find Function | 9 |
| 9 | **Circles and Spheres, Squares Cubes**<br>Finding areas and volumes by using the "Reverse Process" | 9 |
| 10 | **Intuition and Logic**<br>Limitations of the intuitive approach<br>Curves without direction | 9 |

## NML 3

### AN INTRODUCTION TO INEQUALITIES

by E. BECKENBACH AND R. BELLMAN

A facility in handling inequalities is indispensable to the student of mathematical analysis. This introduction begins with an axiomatic treatment of inequalities comprehensible to many ninth graders. Chapter 4, on proofs of the classical inequalities, will be regarded as difficult even by most juniors and seniors, while the powerful applications to optimum problems (usually treated only in the framework of calculus) can be enjoyed with less effort.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Fundamentals**<br>Basic definitions and axioms<br>Positive and negative numbers | 9 and 11 |
| 2 | **Tools**<br>Basic inequality theorems | 9, 11 and 12 |
| 3 | **Absolute Value**<br>Definitions of absolute value<br>Graphs<br>The function sign $x$<br>Graphs of inequalities<br>The "triangle" inequality | 9, 11 and 12 |
| 4 | **The Classical Inequalities**<br>Proofs of: arithmetic mean—geometric mean inequality, Cauchy-Schwarz inequality, Hölder inequality, triangle inequality (for $n$ dimensions), Minkowski inequality | 12 |

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| | | |
|---|---|---|
| 5 | **Maximization and Minimization Problems**<br>Maximum area enclosed by figures with given perimeter<br>Reflection and refraction properties of light rays (Fermat's principle)<br>Tangents to an ellipse | 12 |
| 6 | **Properties of Distance**<br>Euclidean distance function<br>Some non-euclidean distance functions | 12 |

## NML 4

### GEOMETRIC INEQUALITIES

by N. D. KAZARINOFF

This informal book will appeal to geometry students. The only analytical part is a presentation of the arithmetic mean-geometric mean inequality quite different from that given in **NML 3**. The rest of the book discusses fascinating geometry problems, the emphasis being on the famous isoperimetric theorems. The reflection principle and Steiner's symmetrization are discussed and problem solving receives much attention.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Arithmetic and Geometric Means**<br>Arithmetic-geometric mean inequality<br>Applications to extremum problems | 10, 11 and 12 |
| 2 | **Isoperimetric Theorems**<br>Derivation of Heron's formula<br>Isoperimetric theorems for triangles and other polygons (in dual pairs)<br>Steiner's contribution | 10 |
| 3 | **The Reflection Principle**<br>Symmetry<br>Dido's problem<br>Steiner symmetrization<br>Extreme properties of conic sections<br>Triangles (extreme properties; Erdös-Mordell theorem) | 10 |
| 4 | **Solutions of Problems** | 10 |

## NML 5

### THE CONTEST PROBLEM BOOK

*Problems From The Annual High School Contests*
*of The Mathematical Association of America*
*compiled and with solutions*

by C. T. SALKIND

This book contains the problems from the annual contests held during the period 1950 to 1960. The problems are based on the high school curriculum and their solution does not require any mathematics beyond high school geometry and intermediate algebra although, of course, more advanced methods can give "simpler solutions". A classified index of problems according to subject matter helps make this book an excellent and easy-to-use source of problems.

## NML 6

### The Lore of Large Numbers

by P. J. Davis

This charmingly written book can be understood by high school students at all levels, and those who read it will not only gain some intimacy with numbers, big and small, but will learn to work with them and understand some of their less obvious properties. The appendix contains lists of magnitudes not likely to be found anywhere else.

| *Section* | *Topics** | *Grade* |
|---|---|---|
| 1-4 | **Large Numbers and Their Arithmetic**<br>Numbers, their principal uses, their representation through the ages, decimal and binary systems | 9 |
| 5-9 | Use of exponents in writing numbers, names of large numbers, laws of exponents, scientific notation, examples of large numbers | 9 |
| 10-12 | Approximate computation, order of magnitude, estimation | 9 |
| 13-16 | Negative exponents and small numbers, properties of zero | 9 |
| 17-19 | **Large Numbers at Work**<br>The number $\pi$, its history, its properties; computing machines, normal numbers, squaring the circle, estimating the value of $\pi$ | 9, 10, 11 |
| 20-21 | Number theory (prime numbers, perfect numbers, triangular numbers, divisibility criteria), number theory of residues, casting out nines | 9 |
| 22-24 | Simultaneous linear equations, growth of sequences, astronomical and atomic numbers | 9 and 11 |

## NML 7

### Uses of Infinity

by L. Zippin

Professor Zippin, aware of the vague popular and the philosophical connotations of the word "infinity", shows how mathematicians have transformed this almost mystic concept into a no less exciting precise tool essential in all branches of mathematics. The many concrete illustrations of infinity can be understood by juniors and seniors. In the course of this book the author returns to many of the topics he treats intuitively in the beginning and handles them with increasing precision and rigor. This is a book that can be read on many levels; it can serve as an excellent preparation for the concepts of the calculus.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Popular and Mathematical Infinities**<br>Categories of infinity | 9 |
| 2 | **From Natural Numbers to $\sqrt{2}$**<br>Natural, cardinal, and ordinal numbers, positional notation, infinities in geometry, sequences and series, geometry echoes arithmetic, method of exhaustion, irrationality of and approximations to $\sqrt{2}$ | 11 |
| 3 | **From $\sqrt{2}$ to the Transfinite**<br>Incommensurable magnitudes, geometric constructions, limit points, existence of limits, limit of a sequence, Bolzano-Weierstrass theorem and the real numbers, cardinal infinities, Cantor's proof that the real numbers are uncountable, the continuum | 10, 11 and 12 |
| 4 | **Zig-zags**<br>Lengths of polygonal paths, sequential limit points, convergence | 12 |
| 5 | **The Self Perpetuating Golden Rectangle**<br>Fibonacci sequence, golden rectangle, properties of the golden mean, a similarity transformation, logarithmic spiral, pentagon and the golden mean | 10 and 11 |
| 6 | **Constructions and Proofs**<br>Parallel lines divide any two transversals proportionally (incommensurable case), recursive definitions, mathematical induction, sequences and their growth, applications of the principle of "Dirichlet boxes" to residues modulo $N$ of elements in sequences | 12 |

## NML 8

### GEOMETRIC TRANSFORMATIONS

by I. M. YAGLOM

This book introduces the student of geometry to a completely different way of looking at familiar geometrical facts. It is concerned with transformations of

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the plane that do not alter the shapes and sizes of geometric figures. The methods developed supply the student with powerful problem solving techniques, and problems form an essential part of the book. Detailed solutions to all problems are given.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| Intro-duction | **What Is Geometry?**<br>Geometry defined as the study of those properties of geometric figures that remain unchanged under rigid motions | 10 |
| I | **Displacements**<br>Translations<br>Sequences of translations<br>Half turns and rotations<br>Sequences of half turns and half turns and translations<br>Sum of a rotation and a translation is a rotation through the same angle as the original rotation, but with a different center | 10 |
| II | **Symmetry**<br>Reflections<br>Symmetry with respect to a line<br>Combinations of reflections<br>Transformations of the plane<br>Sum of an even number of reflections is a rotation or translation<br>Sum of an odd number of reflections is a reflection or a glide reflection<br>Isometries in the plane<br>Directly congruent and oppositely congruent figures<br>Directly congruent figures can be brought into coincidence by a translation or a rotation<br>Oppositely congruent figures can be brought into coincidence by a reflection or glide reflection | 10 |

NML 9

### CONTINUED FRACTIONS

by C. D. OLDS

This easy-going discussion of simple continued fractions begins with an account of how rational fractions can be expanded into continued fractions and gradually introduces the reader to such diverse topics as the solution of linear Diophantine equations, expansion of irrational numbers into infinite continued fractions, and rational approximation to irrational numbers.

It can be read with profit and interest by capable high school seniors.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Expansion of Rational Fractions**<br>Definition of continued fractions<br>Every rational number can be expressed as a finite continued fraction, and conversely, any finite simple continued fraction represents a rational number<br>Euclidean algorithm for finding the greatest common divisor of two integers<br>Convergents and their properties<br>Historical background | 11 |
| 2 | **Diophantine Equations**<br>Euler's method for solving linear Diophantine equations<br>Solution of linear indeterminate equations by continued fractions | 11 |
| 3 | **Expansion of Irrational Numbers**<br>Properties of convergents of infinite continued fractions<br>Limits<br>An irrational number is the limit of the convergents of its expansion into an infinite simple continued fraction<br>Approximating irrational numbers<br>Geometric interpretation of continued fractions<br>Solution of quadratic equations by continued fractions<br>Fibonacci numbers<br>A method for calculating logarithms | 12 |
| 4 | **Periodic Continued Fractions**<br>Quadratic irrationals of the form $A + B\sqrt{D}$<br>Every periodic continued fraction represents a quadratic irrational, and conversely, any quadratic irrational has a continued fraction expansion which is periodic<br>Continued fraction expansion for $\sqrt{N}$<br>Solution of Pell's equation, $x^2 - Ny^2 = \pm 1$ | 12 |
| 5 | Hurwitz's Theorem — Any irrational number $x$ has an infinity of rational approximations $p/q$ which satisfy the inequality | 12 |

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|---|---|---|
| | $\left\lvert \alpha - \frac{p}{q} \right\rvert < \frac{1}{\sqrt{5}\, q^2}, \qquad q \geqq 1$<br>The number $\sqrt{5}$ is the best possible number; the theorem would become false if any larger number were substituted for $\sqrt{5}$ | |
| Appendix I | Proof that $x^2 - 3y^2 = -1$ has no integral solutions | 12 |
| Appendix II | Miscellaneous continued fractions of historical interest | 12 |

## NML 10

### GRAPHS AND THEIR USES

by OYSTEIN ORE

This book shows how graphs (i.e., networks) may be employed for such diverse purposes as representing a biological breeding experiment, scheduling a chess tournament in the most efficient manner, determining the cheapest way of building a railroad net, and analyzing winning (or losing) positions in certain games. As the reader studies these varied applications, he becomes interested in the theory of graphs for its own sake and for the purpose of applying graph methods to mathematical problems. Professor Ore presents and proves Euler's formula for polyhedra and, in his concluding discussion of the famous *Four Color Conjecture,* he proves that no more than five colors are needed to color any map of the globe in such a way that countries with common boundary curves have different colors.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **What Is a Graph?**<br>Definition of a graph; null graphs and complete graphs; isomorphic graphs; planar graphs; the solution of the *Utility Problem* by means of the Jordan Curve Theorem; the number of odd vertices of a graph is even | 9 |
| 2 | **Connected Graphs**<br>The *Königsberg Bridge Problem;* Euler graphs; Hamilton lines; solution of the *Ferryman's Puzzle* by means of graphs | 9 |
| 3 | **Trees**<br>Relation between vertices and edges of a tree; relation between components, vertices and edges of a forest; circuits and trees; the circuit rank or cyclotomic number of a graph; a problem in communication; streets and squares | 11 |

4 **Matchings** 11
Matching men and jobs; round-robin matchings

5 **Directed Graphs** 11
Team competitions; the problem of one way traffic; genetic graphs

6 **Games and Puzzles** 11
Formulation of puzzles in terms of graphs; theory of games; *The Sportswriter's Paradox*

7 **Relations** 11
Relations and graphs; special relations; equivalence relations; congruences; partial order

8 **Planar Graphs** 11
Conditions determining a planar graph; Euler's formula; dual graphs; the Platonic bodies (regular polyhedra); mosaics

9 **Map Coloring** 11
Four Color Conjecture; Five Color Theorem

**NML 11, 12**

### HUNGARIAN PROBLEM BOOK I, II

*based on the Eötvös Competitions, 1894-1928*

The Eötvös Competitions are open to Hungarian students in their last year of high school. Each year three challenging problems are proposed. The leading proponent of these contests, the mathematician and pedagogue J Kürschák (1964-1933), compiled all problems given from 1894 to 1928; he wrote ingenious, elegant solutions (sometimes using those of the contest winners, often giving several methods of solution) and many enlightening explanatory notes which open the door to various mathematical fields. **NML** 11 and 12 are translations of a revised Hungarian edition of Kürschák's book. These problems have become famous for the simplicity of the concepts employed, the mathematical depth reached, and the diversity of elementary mathematical fields touched. Many problems are on elementary number theory, a field hitherto hardly treated in American secondary schools. At the back of each volume there is a list of problems classified according to the mathematical area involved. These volumes will stimulate our best students and can keep mathematics clubs and student publications alert and active.

**NML 13**

## EPISODES FROM THE EARLY HISTORY OF MATHEMATICS
by ASGER AABOE

This delightful account of representative topics from ancient mathematics brings out the cumulative nature of mathematical knowledge and its universality in time and place. Most of the book is sufficiently elementary to be understood and enjoyed by tenth grade students. In Chapter 1 Professor Aaboe describes Babylonian mathematics as revealed from cuneiform texts discovered only during the last half century. In subsequent chapters he treats topics reconstructed from Euclid's *Elements*, from the writings of Archimedes, and from Ptolemy's *Almagest*, staying as close to the original texts as is comfortable for a modern reader. Each chapter can be read as a separate unit and the bibliography assists the interested student to delve more deeply into any aspect of ancient mathematics that catches his fancy.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Babylonian Mathematics** | 9 and 11 |
| | The Babylonian number system, a positional number system with base 60 | |
| | Reconstruction of a multiplication table and table of reciprocals from Old Babylonian tablets | |
| | Positional number systems | |
| | Babylonian arithmetic | |
| | Babylonian texts: solution of quadratic equations; diagonal of a square (Pythagorean theorem and irrational numbers); area of a trapezoid | |
| | An appraisal of Babylonian mathematics | |
| 2 | **Early Greek Mathematics and Euclid's Construction of the Regular Pentagon** | 10 |
| | Greek mathematics before Euclid | |
| | Euclid's *Elements* | |
| | Axiomatic development of geometry | |
| | Euclid's proof that there are infinitely many primes | |
| | Euclid's construction of the regular pentagon | |

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| 3 | **Three Samples of Archimedean Mathematics**<br>Archimedes' life<br>Archimedes' works<br>Constructions of regular polygons<br>Archimedes' trisection of an angle<br>Archimedes' construction of the regular heptagon<br>Volume and surface of a sphere according to *The Method* | 10 |
| 4 | **Ptolemy's Construction of a Trigonometric Table**<br>The *Almagest*<br>Ptolemy's table of chords used in the solution of triangles<br>The construction of Ptolemy's table of chords | 11 |
| Appendix | **Ptolemy's Epicyclic Models** | 11 |

## NML 14

### GROUPS AND THEIR GRAPHS

by I. GROSSMAN and W. MAGNUS

Despite the abstract nature of the subject, the authors of this lucid introduction to group theory have succeeded in presenting the material in a way that can be understood and appreciated by high school juniors and seniors. The careful progression from the simple to the complex and from the concrete to the abstract is especially noteworthy. The effective use of "Cayley Diagrams" helps a student to visualize the structure of a group and to acquire a good intuitive grasp of this important subject.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Introduction to Groups**<br>Examples of groups<br>Examples and definition of a binary operation<br>Structural pattern of a group: a set together with a binary operation on the set | 11 |
| 2 | **Group Axioms**<br>Associativity<br>Unit or identity element<br>Inverse elements | 11 |
| 3 | **Examples of Groups**<br>Group of integers under addition; the set with elements —1, 1 under multiplication; group of rotations of an equilateral triangle; group with elements 0, 1 and binary operation "addition modulo 2"; etc. | 11 |

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|---|---|---|
| 4 | **Multiplication Table of a Group**<br>Abelian and non-commutative groups<br>Graphs of groups<br>Structure of the multiplication table of a group<br>"Solving" a group "equation" | 11 |
| 5 | **Generators of a Group**<br>Cyclic groups | 11 |
| 6 | **Graph of a Group**<br>**(Cayley Diagram)**<br>Infinite cyclic group<br>Correspondence between a group and its graph<br>Dihedral groups | 11<br>11 |
| 7 | **Definition of a Group by Generators and Relations**<br>Determination of the cyclic group of order 3, $C_3$, by defining relations<br>Determination of the dihedral group of order 6, $D_3$, by a set of relations<br>Generators and relations of the dihedral group $D_n$<br>The dihedral group $D_\infty$<br>Direct products | 12 |
| 8 | **Subgroups**<br>Theorem of Lagrange: The order of a finite group is a multiple of the order of any subgroup<br>Cosets of a group<br>Proof of Fermat's theorem, $a^p = a \pmod{p}$ | 11 and 12 |
| 9 | **Mappings**<br>Mappings as elements of a group<br>Homomorphism and isomorphism<br>Abstract groups | 12 |
| 10 | **Permutation Groups**<br>A finite group is isomorphic to a permutation group<br>The tetrahedral group<br>Symmetric groups<br>Alternating groups | 12 |
| 11 | **Normal Subgroups**<br>Normal subgroups and homomorphic mapping<br>Subgroups of an Abelian group are normal<br>Factor (quotient) groups | 12 |
| 12 | **The Quaternion Group** | 12 |

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|---|---|---|
| 13 | **Symmetric and Alternating Groups**<br>Symmetric groups and symmetric polynomials<br>Application to quadratic equations<br>Transpositions<br>Alternating groups and alternating polynomials | 12 |
| 14 | **Path Groups**<br>Homotopy<br>Manifolds | 12 |
| 15 | **Groups and Wallpaper Designs**<br>Plane covering designs | 12 |
| Appendix | **Group of the Dodecahedron and the Icosahedron** | 12 |

**NML 15**

### THE MATHEMATICS OF CHOICE
### *(How to Count Without Counting)*
by IVAN NIVEN

Combinatorial mathematics, the subject of this book, is taken up in many high schools under the heading "permutations and combinations." Thus some students will already be familiar with the beginning material in parts of the first three chapters. In the later chapters a variety of more advanced methods are given for solving more difficult questions about many aspects of counting. Answers are given for all problems. Solutions are given for all problems of any depth, in detail for problems in the early chapters, in outline form only for some of the later problems.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | **Introduction**<br>Examples of the questions raised in the book | 9 |
| 2 | **Permutations and Combinations**<br>The multiplication principle<br>Factorials<br>Permutations<br>Zero factorial<br>Combinations<br>Permutations of things in a circle | 9 and 10 |
| 3 | **Combinations and Binomial Coefficients**<br>A path problem<br>Permutations of things not all alike<br>Pascal's formula for combinations<br>Binomial expansion<br>Pascal's triangle<br>Subsets of a set<br>Sums of powers of natural numbers | 10 and 11 |

4 **Some Special Distributions** 12
Fibonacci numbers
Linear equations with unit coefficients
Combination with repetitions
Equations with restricted integer solutions

5 **Inclusion-Exclusion Principle** 12
Combinations with repetitions
Equations with restricted solutions
Derangements
Probability

6 **Partitions of an Integer** 12
Graphs of partitions

7 **Generating Polynomials** 12
Partitions and products of polynomials
Change for a dollar bill

8 **Distribution of Objects Not All Alike** 12
Distributions of objects in boxes
Partitions of a set

9 **Configuration Problems** 12
Pigeonhole principle
Chromatic triangles
Geometric separations

10 **Mathematical Induction** 12
Notation for sums and products

11 **Interpretation of a Non-associative Product** 12
A recursion relation
**Miscellaneous Problems**

## NML 16

### FROM PYTHAGORAS TO EINSTEIN

by K. O. FRIEDRICHS

The main thread running through this monograph is the Pythagorean theorem, first in its most elementary geometric form, then in algebraic garb, in modified form, reinterpreted as one of the main characters in the special theory of relativity. The first three chapters can be understood by any student acquainted with the Pythagorean theorem, and the fourth generalizes the concepts introduced in the third. The remaining part of the book will be difficult for students who have never studied physics, although the author employs only the notion of impact and presupposes no background in physics. He uses the laws of conservation of momentum and of energy and, in this framework, with the aid of the vector geometry introduced earlier, leads the reader to the famous formula $e=mc^2$.

| *Chapter* | *Topics* | *Grade* |
|---|---|---|
| 1 | The Pythagorean Theorem | 10 |
| 2 | Signed Numbers | 9 and 11 |
| 3 | Vectors | 11 and 12 |
| 4 | Components and Coordinates. Spaces of Higher Dimension | 11 and 12 |
| 5 | Momentum and Energy. Elastic Impact | 12 |
| 6 | Inelastic Impact | 12 |
| 7 | Space and Time Measurement in the Special Theory of Relativity | 12 |
| 8 | Momentum and Energy in the Special Theory of Relativity. Impact | 12 |

# II

## Topics in NML Books Suggested for Each Grade Level

### GRADE 9

| | |
|---|---|
| **Approximation** | 6, §10-§12; 12, 1928/1 |
| **Computing machines** | 6, §18 |
| **Combinatorics** | 15, Ch. 1, Ch. 2 |
| **Graphs** | |
| Graphical representation of velocity | 2, Ch. 2 |
| Graphs of inequalities | 3, Ch. 3 |
| Slope of a curve | 2, Ch. 6 |
| **Inequalities** | 3, Ch. 1, Ch. 2; 12, 1907/3, 1913/1 |
| Graphs of inequalities | 3, Ch. 3 |
| Triangle inequality | 3, Ch. 3 |
| **Linear equations** | 6, §22 |
| **Logic** | 12, 1916/3, 1928/2 |
| **Networks (topology)** | 10, Ch. 1, Ch. 2 |
| **Numbers and number systems** | |
| Babylonian number system (base 60) | 13, Ch. 1 |
| Binary system | 6, §4 |
| Decimal representation | 1, Ch. 2, Ch. 3; 12, 1907/3, 1917/2, 1925/2, 1927/2 |
| Periodic decimals | 1, Ch. 2 |
| Positional notation | 12, 1925/2 |
| Real numbers | 1, Ch. 3 |
| Irrational numbers | 1, Ch. 3 |
| Rational numbers | 1, Ch. 2 |
| Real number line | 1, Ch. 3 |
| **Number theory** | |
| Composite numbers | 6, §20 |
| Congruence modulo p | 6, §21; 11, 1898/1 |
| Divisibility | 1, Ch. 1; 6, §20; 11, 1899/3; 12, 1908/1, 1911/3, 1925/1 |
| Divisibility criteria | 6, §20 |
| Natural numbers and integers | 1, Ch. 1; 12, 1906/3, 1913/1, 1926/2 |
| Normal numbers | 6, §18 |
| Perfect numbers | 6, §20; 11, 1903/1 |

| | |
|---|---|
| Primes | 1, Ch. 1, App. A; 6, §20, 12, 1923/3; 13, Ch. 2 |
| Triangular numbers | 6, §20 |
| Unique factorization | 1, App. B |
| **Pigeonhole principle** | 12, 1906/3, 1907/3, 1925/1, 1928/1 |
| **Topics from Physics** | |
| Acceleration | 2, Ch. 7 |
| Constant speed | 2, Ch. 2 |
| Instantaneous velocity | 2, Ch. 3 |
| Scientific notation | 6, §8 |
| Varying speed | 2, Ch. 2 |

## GRADE 10

| | |
|---|---|
| **Combinatorics** | 15, Ch. 1, Ch. 2 |
| **Extremum problems** | 4, Ch. 2, Ch. 3; 12, 1928/3 |
| **Geometric constructions** | 7, Ch. 3; 8; 11, 1894/2, 1895/2, 1896/3, 1898/3, 1900/2 |
| Archimedes' construction of a regular heptagon | 13, Ch. 3 |
| Archimedes' trisection of an angle | 13, Ch. 3 |
| Euclid's construction of a regular pentagon | 13, Ch. 2 |
| **Geometry** | All of 8; 11, 1894/3, 1895/3, 1897/3, 1903/3, 1904/1, 1904/3, 1905/3; 12, 1906/2, 1907/2, 1908/3, 1909/3, 1912/3, 1914/1, 1914/3, 1915/2, 1915/3, 1916/2, 1917/3, 1918/1, 1923/1, 1924/3, 1925/3, 1926/3, 1928/3 |
| Golden rectangle | 7, Ch. 5 |
| Groups of transformations | 14, Ch. 1, Ch. 2, Ch. 3 |
| Incommensurable lengths | 1, Ch. 3; 7, Ch. 3, Ch. 6 |
| Isoperimetric theorems | 4, Ch. 2 |
| Pythagorean theorem | 16, Ch. 1 |
| Reflection principle | 4, Ch. 3 |

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|---|---|
| Transformations of the plane (length preserving) | All of **8** |
| **Inequalities** | **4**, Ch. 2, Ch. 3; **11**, 1904/3; **12**, 1912/3, 1914/1, 1915/2, 1915/3, 1916/2, 1925/3 |
| **Means** | |
| Arithmetic mean—geometric mean inequality | **4**, Ch. 1 |
| Geometric mean | **12**, 1916/2 |
| Harmonic mean | **11**, 1905/3 |
| **Networks (topology)** | **10**, Ch. 1, Ch. 2 |
| **The number** $\pi$ | **6**, §19 |
| **Vectors** | **16**, Ch. 3, Ch. 4 |

## GRADE 11

| | |
|---|---|
| **Binary operation on a set** | **14**, Ch. 1 |
| **Binominal coefficients** | **15**, Ch. 3 |
| **Binomial theorem** | **11**, 1902/1; **15**, Ch. 3 |
| **Calculus (first concepts)** | All of **2** |
| Limits | **7**, Ch. 3 |
| **Continued fractions** | **9**, Ch. 1, Ch. 2 |
| **Extremum problems** | **4**, Ch. 1; **11**, 1902/3 |
| **Group theory** | **14**, Ch. 1-Ch. 6, Ch. 8 |
| **Inequalities** | **3**, Ch. 1-Ch. 3; **4**, Ch. 1; **11**, 1897/2, 1898/2, 1905/1; **12**, 1908/2, 1910/1, 1911/1, 1915/1, 1916/2, 1918/2, 1924/1, 1927/3 |
| **Logarithmic function** | **1**, Ch. 5; **7**, Ch. 5 |
| **Means** | |
| Arithmetric mean | **12**, 1916/2 |
| Arithmetic mean—geometric mean inequality | **3**, Ch. 4; **4**, Ch. 1; **12**, 1916/2 |
| Geometric mean | **12**, 1916/2, 1927/3 |
| Harmonic mean | **3**, Ch. 4; **12**, 1910/3 |
| **Networks (graph theory)** | All of **10** |
| Path problem | **15**, Ch. 3 |
| **Nomography** | **12**, 1910/3 |

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| | |
|---|---|
| **Number theory** | |
| Congruence modulo p | 10, Ch. 7; 11, 1898/1, 1901/1 |
| Diophantine equations | 9, Ch. 2; 11, 1894/1, 1904/2;<br>12, 1926/1; 15, Ch. 4 |
| Divisibility | 11, 1894/1, 1900/1, 1901/3;<br>12, 1913/3, 1927/1 |
| Euclid's algorithm | 9, Ch. 1 |
| Fermat's conjecture | 12, 1909/1 |
| Prime factorization | 1, App. B; 11, 1896/1 |
| Prime numbers | 1, Ch. 1, App. A; 6, §20;<br>11, 1894/1; 13, Ch. 2 |
| Relatively prime numbers | 11, 1901/3 |
| **Polynomials** | 11, 1902/1; 12, 1907/1 |
| Rational roots of polynomial equations | 1, Ch. 4 |
| **Quadratic equations** | 11, 1896/2, 1899/2, 1901/2;<br>12, 1907/1 |
| **Quadratic functions** | 11, 1902/1 |
| **Real number system** | |
| Algebraic numbers | 1, Ch. 4, Ch. 5 |
| Approximation to $\sqrt{2}$ | 7, Ch. 2 |
| Continuum | 7, Ch. 3 |
| Decimal representation | 1, Ch. 2, Ch. 3; 12, 1925/2 |
| Periodic decimals | 1, Ch. 2 |
| Irrational numbers | 1, Ch. 4 |
| Irrationality of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{2} + \sqrt{3}$ etc. | 1, Ch. 3; 7, Ch. 2 |
| Rational numbers | 1, Ch. 2 |
| Expansions into simple continued fractions | 9, Ch. 1 |
| Real number line | 1, Ch. 3 |
| **Set theory** | |
| Cardinal numbers | 7, Ch. 2 |
| Ordinal numbers | 7, Ch. 2 |
| Subsets of a set | 15, Ch. 3 |
| Uncountable sets | 7, Ch. 3 |
| **Sequences and series** | 6, §23; 7, Ch. 2 |
| Fibonacci sequence | 7, Ch. 5 |
| Geometric progressions | 11, 1905/2 |

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| | |
|---|---|
| **Systems of equations** | 11, 1905/1 |
| **Topics from physics** | 11, 1900/3; 12, 1910/3 |
| **Trigonometry** | 11, 1894/3, 1895/3, 1897/1, 1897/2, 1898/2, 1901/2, 1902/3, 1903/2; 12, 1910/3 |
| Ptolemy's construction of a trigonometric table | 13, Ch. 4 |
| Trigonometric functions | 1, Ch. 5 |

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## GRADE 12

| | |
|---|---|
| **Binomial theorem** | 12, 1923/2; 15, Ch. 3 |
| **Calculus** | All of 2 |
| Limits | 7, Ch. 3; 9, Ch. 3 |
| **Combinatorics** | 12, 1912/1; all of 15 |
| Combinations | 11, 1895/1; 15, Ch. 2-Ch. 5 |
| Permutations | 11, 1895/1; 15, Ch. 2-Ch. 5 |
| **Complex numbers** | 11, 1899/1 |
| **Continued fractions** | All of 9 |
| **Distance functions (euclidean and non-euclidean)** | 3, Ch. 6 |
| **Extremum problems** | 3, Ch. 5; 4, Ch. 1, Ch. 3 |
| Existence of extrema | 4, Ch. 2; 11, 1898/2 |
| **Game theory** | 10, Ch. 6 |
| **Geometry** | |
| Constructions with straightedge and compasses | 1, Ch. 5; 13, Ch. 3 |
| Geometric interpretation of continued fractions | 9, Ch. 3 |
| Isoperimetric theorems | 3, Ch. 5; 4, Ch. 2 |
| Loci | 8; 12, 1924/2 |
| Non-euclidean geometry | 11, 1902/2; 13, Ch. 2 |
| Regular polyhedra | 10, Ch. 8 |
| Solid geometry | 11, 1902/2; 12, 1913/2, 1922/1 |
| Volume and surface of a sphere according to Archimedes | 13, Ch. 3 |
| **Group theory** | All of 14 |

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| | |
|---|---|
| **Inequalities** | All of 3; 12, 1909/2, 1914/2, 1916/2, 1918/3, 1922/3 |
| Arithmetic mean—geometric mean inequality | 3, Ch. 4; 4, Ch. 1; 12, 1916/2 |
| Classical inequalities of analysis | 3, Ch. 4 |
| **Mappings** | 14, Ch. 9 |
| Homomorphism | 14, Ch. 9 |
| Isomorphism | 14, Ch. 9 |
| **Mathematical induction** | 7, Ch. 6; 15, Ch. 10 |
| **Means** | |
| Arithmetic mean | 4, Ch. 1; 12, 1909/2, 1916/2 |
| Arithmetic mean—geometric mean inequality | 3, Ch. 4; 4, Ch. 1; 12, 1916/2 |
| Geometric mean | 3, Ch. 4; 4, Ch. 1; 12, 1916/2 |
| Harmonic mean | 3, Ch. 4; 12, 1909/2 |
| **Networks (graph theory)** | All of 10 |
| Graphs of groups (Cayley diagrams) | 14, Ch. 6 |
| Graphs of partitions | 15, Ch. 6 |
| **Number theory** | |
| Congruence modulo p | 10, Ch. 7; 11, 1898/1, 1901/1 |
| Diophantine equations | 9, Ch. 2, App. I; 11, 1894/1, 1904/2; 12, 1926/1; 15, Ch. 4, Ch. 5 |
| Divisibility | 1, Ch. 1; 6, §20; 11, 1894/1, 1900/1, 1901/3; 12, 1910/2, 1912/2, 1913/3, 1927/1 |
| Euclid's algorithm | 9, Ch. 1 |
| Fermat's conjecture | 12, 1909/1 |
| Fermat's theorem | 11, 1901/1; 14, Ch. 8 |
| Pell's equation | 9, Ch. 4 |
| Prime factorization | 1, App. B; 11, 1896/1 |
| Prime numbers | 1, Ch. 1, App. A; 6, §20; 11, 1894/1; 12, 1923/3; 13, Ch. 2 |
| Relatively prime numbers | 11, 1901/3 |
| **Partitions** | 15, Ch. 6-Ch. 8 |
| **Polynomials** | 1, Ch. 4, Ch. 7, App. C; 11, 1899/1; 12, 1914/2, 1922/2 |

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| | |
|---|---|
| Factoring | 12, 1922/2 |
| Generating polynomials | 15, Ch. 7 |
| Trigonometric polynomials | 12, 1911/2 |
| **robability** | 15, Ch. 5 |
| **uadratic equations** | 9, Ch. 3, Ch. 4; 11, 1896/2; 12, 1916/1 |
| **uadradic functions** | 12, 1914/2, 1918/3 |
| **eal number system** | |
| Algebraic numbers | 1, Ch. 4, Ch. 5 |
| Approximation of irrationals by rationals | 1, Ch. 6; 9, Ch. 5 |
| Approximation to $\sqrt{2}$ | 7, Ch. 2 |
| Continuum | 7, Ch. 3 |
| Decimal representation | 1, Ch. 2, Ch. 3; 12, 1925/2 |
| Periodic decimals | 1, Ch. 2 |
| Existence of transcendental numbers | 1, Ch. 7, App. C |
| Expansion of quadratic irrationals in periodic continued fractions | 9, Ch. 4 |
| Irrational numbers | 1, Ch. 4 |
| Irrationality of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{2} + \sqrt{3}$, etc. | 1, Ch. 3; 7, Ch. 2 |
| Liouville's construction of a transcendental number | 1, Ch. 7 |
| Rational numbers | 1, Ch. 2; 12, 1906/1 |
| Expansions into simple continued fractions | 9, Ch. 1 |
| Real number line | 1, Ch. 3 |
| Uncountability of real numbers | 1, App. C; 7, Ch. 3 |
| **elations** | 10, Ch. 7 |
| Equivalence relation | 10, Ch. 7 |
| Partial order | 10, Ch. 7; 3, Ch. 1, Ch. 2 |

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| | |
|---|---|
| **Set theory** | |
| Cardinal numbers | 7, Ch. 2 |
| Ordinal numbers | 7, Ch. 2 |
| Subsets of a set | 15, Ch. 3 |
| Uncountable sets | 7, Ch. 3 |
| **Sequences and series** | |
| Fibonacci sequence | 7, Ch. 5, Ch. 6; 9, Ch. 3; 15, Ch. 4 |
| Geometric progression | 12, 1922/3, 1923/2 |
| Growth of sequences | 6, §23; 7, Ch. 6 |
| Sequential limit points | 7, Ch. 4 |
| **Systems of equations** | 12, 1917/1 |
| **Topics from physics** | |
| Conservation laws | 16, Ch. 5, Ch. 6 |
| Energy | 16, Ch. 5, Ch. 6, Ch. 7, Ch. |
| Impact | 16, Ch. 5, Ch. 6 |
| Momentum | 16, Ch. 5, Ch. 6, Ch. 7, Ch. |
| Problem in heat flow | 6, §22 |
| Reflection and refraction of light rays | 3, Ch. 5 |
| Special theory of relativity | 16, Ch. 7, Ch. 8 |

## INFORMATION ON ORDERING

Three separate editions of the New Mathematical Library a now available:

A paper bound edition is published by Random House, Inc. Eac volume in this edition is priced at $1.95. This edition is availab in book stores or may be ordered by mail from:

Random House, Inc.
457 Madison Avenue
New York, New York 10022

A hard bound library edition is distributed by Random Hous School and Library Services, Inc. Each volume in this edition priced at $2.95, and can be ordered from:

Random House School and Library Services, Inc.
457 Madison Avenue
New York, New York 10022

A special school edition is available from The L. W. Singe Company **to elementary and secondary schools.** Each volume in thi edition is priced at $.90 and can be ordered from:

The L. W. Singer Company, Inc.
249 West Erie Boulevard
Syracuse, New York 13201

In addition to the published books listed on pp. 4 and 5, ther is available free of charge a 9 by 6 inch Reference Guide to th New Mathematical Library containing a preface and the informa tion of this Newsletter (except for references to NML 16). Thi booklet will be brought up to date periodically and can be ordere from the L. W. Singer Company.

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## SMSG ORDER FORM

## "NEW MATHEMATICAL LIBRARY"

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Syracuse, New York 13201

| Quantity | | Net Price | Total |
|---|---|---|---|
| ______ | Niven — Numbers: Rational and Irrational (NML-1) | $ .90 | ______ |
| ______ | Sawyer — What Is Calculus About? (NML-2) | $ .90 | ______ |
| ______ | Beckenbach and Bellman — An Introduction to Inequalities (NML-3) | $ .90 | ______ |
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| ______ | Friedrichs — From Pythagoras to Einstein (NML-16) (in preparation) | $ .90 | ______ |

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# SCHOOL
# MATHEMATICS
# STUDY GROUP

## Newsletter No. 22

*April 1966*

## SMSG PUBLICATIONS

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# CONTENTS

New Publications, 5

- Algorithms, Computation and Mathematics, 5
- Spanish Translations, 5
- New Mathematical Library, 5
- Mathematics for Culturally Disadvantaged Children, 5
- Studies in Mathematics, 6

How to Obtain SMSG Publications, 6

Newsletters, 7

High School Texts, 7

Junior High School Texts, 8

Elementary School Texts, 8

Texts for Slower Students, 9

Programed Algebra Text, 9

New Mathematical Library, 9

Supplementary Materials, 10

Supplementary and Enrichment Series, 11

Spanish Translations, 11

Studies in Mathematics, 12

Study Guides in Mathematics, 12

Filmed Course for Elementary School Teachers, 12

Conference Reports, 13

Miscellaneous Publications, 13

Order Forms, 15

## NEW PUBLICATIONS

The following SMSG publications have appeared since the last SMSG Publications Newsletter No. 20 was issued. For information on obtaining any of these see the listings which follow:

**1. Algorithms, Computation and Mathematics.** This is a one semester course intended for the last year of high school. It is concerned with mathematical concepts which are fundamental to computer science. An important characteristic of the text is that it does not require a specific programming language and instead uses flow charts to describe algorithmic procedures. Two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL. Each of these parallels the main text. There is a teacher's commentary for each text.

The text will be revised during the summer of 1966. The preliminary version is available for inspection. The revised version will be available for general use as of September 1, 1966.

**2. Spanish Translations.** The following additional translations into Spanish of SMSG texts and commentaries are now available:

Matematicas Para La Escuela Secundaria, Introduccion Al Algebra De Las Matrices, Comentario

Matematicas Para La Escuela Secundaria, Funciones Elementales, Comentario

Matematicas Para La Escuela Primaria, Grado 6, Comentario

In addition, a translation of the inservice text for elementary school teachers is now available.

El Curso Conciso En Matematica Para Los Profesores De Escuela Primaria

**3. New Mathematical Library.** Three new monographs are now available:

Mathematics of Choice, by Ivan Niven

From Pythagoras to Einstein, by K. O. Friedrichs

The Contest Problem Book II, by Charles T. Salkind

Note also the price of these monographs has been increased from 90 cents to 99 cents each for the school edition.

**4. Mathematics for Culturally Disadvantaged Children.** During the academic year 1964-65, seven kindergarten and seven first grade classes in culturally disadvantaged areas in six large cities used SMSG text materials. Inservice assistance was provided to the teachers, and the students were tested at the beginning and at the end of the year.

The participating teachers met four times during the year to report on their progress and their special problems.

The information thus gained from this observation program was made use of in the preparation of special editions of the teachers commentary for kindergarten and for grade one, as well as the student workbook for grade one. These, as well as the new volume, Studies in Mathematics, Volume 13 (described below), are designed to help make the SMSG program more accessible to culturally disadvantaged students.

Preliminary versions of these materials are available for inspection. They will all be revised during the summer of 1966 and will be available for general use as of September 1, 1966.

**5. Studies in Mathematics.** The volumes in this series are intended for inservice teachers. Volume 13, Inservice Course for Primary School Teachers, is intended for teachers of culturally disadvantaged children. Characteristics of such children which are important in the learning of mathematics are discussed in the first part of the book. The remaining part of the book is devoted to basic mathematical concepts usually introduced in the primary grades, together with comments on special problems that may be encountered in teaching these concepts to culturally disadvantaged students.

A preliminary version of this book is available for inspection. The book will be revised in the summer of 1966, and the revised version will be available for general use by September 1, 1966.

Studies in Mathematics, Volume 14, "Introduction to Number Systems" is a companion volume to Studies in Mathematics, Volume 5, "Concepts of Informal Geometry." Written by Professor Burton Jones of the University of Colorado, it covers the arithmetic and algebraic concepts needed for the successful teaching of junior high school prealgebra courses.

Attention is called to Studies in Mathematics, Volume 12, "Brief Course for Junior High School Teachers," which is designed explicitly for teachers of the SMSG texts "Mathematics for Junior High School," Volumes 1 and 2.

## HOW TO OBTAIN SMSG PUBLICATIONS

There are two main distributors for SMSG materials. Most of the texts are distributed by the Yale University Press. In the following listings, these are indicated by the symbol Y. An order blank appears on pages 17 and 18.

Most of the other publications are distributed by A. C. Vroman, Inc. In the listings which follow, these are indicated by the symbol V. Order blanks appear on pages 19, 20, 21, 23, 25 and 27.

The calculus textbook will be available from Vroman's until June 30, 1966, after which time it will be available only from the Yale University Press. In the following listing this is indicated by the symbol "VY."

Instructions for ordering other SMSG publications will be found in the listings below.

NOTE: The materials distributed by the Yale University Press and by A. C. Vroman, Inc. are priced at essentially the cost of printing and distribution. Free inspection or desk copies are not possible, and discounts for quantity orders, other than those indicated on the order blanks, cannot be given.

## NEWSLETTERS

In order to keep the mathematical community informed, an SMSG Newsletter is published from time to time. A postcard request is sufficient for one to be placed on the mailing list.

The following issues are still available in limited quantities from: SMSG – Cedar Hall, Stanford University, Stanford, California 94305.

Newsletter No. 10 – Reports on Student Achievement in SMSG Courses
Newsletter No. 15 – Reports
Newsletter No. 17 – Panel on Supplementary Publications
Newsletter No. 19 – Report of a Survey of Inservice Programs for Mathematics Teachers
Newsletter No. 21 – The New Mathematical Library

## HIGH SCHOOL TEXTS

These texts are designed for average and above average students in a college preparatory program. *Geometry with Coordinates* is designed as an alternative to *Geometry* putting more emphasis on analytic geometry. *Matrix Algebra* and *Analytic Geometry* are intended for students who have completed the prerequisites for calculus but wish to postpone study of this subject until college.

*Calculus* appears in three parts. The first two together constitute a normal one year course and cover, for example, the CEEB advanced placement syllabus. Part III, which is available separately, takes up supplementary topics, mainly applications of calculus to the physical sciences.

Each text is accompanied by an extensive teacher's commentary.

| | |
|---|---|
| First Course in Algebra | Y |
| Geometry | Y |
| Geometry with Coordinates | Y |
| Intermediate Mathematics | Y |
| Elementary Functions | Y |
| Introduction to Matrix Algebra | Y |
| Analytic Geometry | Y |
| Calculus | VY |
| Algorithms, Computation and Mathematics | V |

## JUNIOR HIGH SCHOOL TEXTS

These texts review and extend the mathematics of the elementary school in such a way as to provide a sound intuitive foundation for high school courses. A considerable amount of informal geometry is included.

Each text is accompanied by an extensive teacher's commentary.

| | |
|---|---|
| Mathematics for Junior High School, Volume I | Y |
| Mathematics for Junior High School, Volume II | Y |

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4-6 presuppose a conventional program through grade 3. The emphasis in all these texts is similar to that of the Junior High School texts.

In the Teacher's Commentary for each text all pages of the student text are reproduced. For Kindergarten there is only a teacher's book.

| | |
|---|---|
| Mathematics for the Elementary School, Book K (Teacher's Commentary only) | Y |
| Mathematics for the Elementary School, Book 1 | Y |
| Mathematics for the Elementary School, Book 2 | Y |
| Mathematics for the Elementary School, Book 3 | Y |
| Mathematics for the Elementary School, Grade 4 | Y |
| Mathematics for the Elementary School, Grade 5 | Y |
| Mathematics for the Elementary School, Grade 6 | Y |
| Mathematics for the Elementary School, Book K, Special Edition | V |
| Mathematics for the Elementary School, Book 1, Special Edition | V |

## TEXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in the texts for grades 7-9 listed above. However, the level of reading difficulty has been reduced to make them more suitable for students who are slightly below average in ability. It is expected that such students will proceed through these materials at a reduced rate.

Each text is accompanied by an extensive teacher's commentary.

| | |
|---|---|
| Introduction to Secondary School Mathematics, Volume I | Y |
| Introduction to Secondary School Mathematics, Volume II | Y |
| Introduction to Algebra | Y |

## PROGRAMED ALGEBRA TEXT

The text "First Course in Algebra" was redone in programed form for experimental purposes, but is now available for general use. The student uses a separate response booklet, so the text is reusable.

There is a brief teacher's commentary.

| | |
|---|---|
| Programed First Course in Algebra | Y |

## NEW MATHEMATICAL LIBRARY

This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

The authors of these monographs are mathematicians interested and well versed in the fields they treat.

A trade edition of these monographs is available through Random House. In addition, a special edition is available only to high school students and teachers at a reduced rate from the L. W. Singer Co. An order form appears on page 29.

Numbers Rational and Irrational by Ivan Niven
What is Calculus About? by W. W. Sawyer
An Introduction to Inequalities by Beckenbach and Bellman
Geometric Inequalities by Nicholas D. Kazarinoff
The Contest Problem Book by Charles T. Salkind
The Lore of Large Numbers by Philip J. Davis
Uses of Infinity by Leo Zippin
Geometric Transformations by I. M. Yaglom

Continued Fractions by C. D. Olds
Graphs and Their Uses by Oystein Ore
Hungarian Problem Book I
  translated by E. Rapaport
Hungarian Problem Book II
  translated by E. Rapaport
Episodes From Early Mathematics by
  Asger Aaboe
Groups and Their Graphs by Grossman and
  Magnus
*Mathematics of Choice* by Ivan Niven
*From Pythagoras to Einstein* by K. O. Friedrichs
*The Contest Problem Book II* by Charles T.
  Salkind

## SUPPLEMENTARY MATERIALS

A variety of booklets are available. Their common characteristic is that each requires less than a full academic year.

The first three of the following booklets use simple experiments from physical science to introduce and motivate mathematical ideas. They are designed for grades seven, eight, and nine. The later booklets do not presuppose study of the earlier ones.

The fourth booklet below parallels MATHEMATICS THROUGH SCIENCE, Part 2, but uses simple experiments from biological science rather than physical science.

Mathematics Through Science, Part 1 ............ V
Mathematics Through Science, Part 2 ............ V
Mathematics Through Science, Part 3 ............ V
Mathematics and Living Things .................... V

The following three booklets contain material from the preliminary version of the texts for junior high school and are designed to allow a teacher to cover some of the ideas in these texts without being committed to a full two-year program.

Junior High School Mathematics Units,
  Number Systems .................................... V
Junior High School Mathematics Units,
  Geometry .................................... V
Junior High School Mathematics Units,
  Applications .................................... V

The next booklet contains material not included in the textbooks for grades seven and eight and is designed for abler students.

Junior High School Supplementary Unit ...... V

The next two booklets are designed for outside reading by students in grades nine through twelve.

Essays on Number Theory I ........................ V
Essays on Number Theory II........................ V

The following booklet, based on the first chap-

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ter of "Intermediate Mathematics," provides a review of the structural properties of the real number system and of its subsystems.

| | |
|---|---|
| Development of the Real Number System | V |

The last booklet in this list contains selected chapters from the fourth grade text and is designed for students starting the SMSG program with the fifth grade text.

| | |
|---|---|
| Selected Units, Grade 4 | V |

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets are designed to allow teachers to try short modern treatments of (particular) mathematics topics in class. Some, however, are designed for independent study or enrichment. Teacher's commentaries are available for some of these.

| | |
|---|---|
| Functions | V |
| Circular Functions | V |
| The Complex Number System | V |
| The System of Vectors | V |
| Non-Metric Geometry | V |
| Plane Coordinate Geometry | V |
| Inequalities | V |
| Numeration | V |
| Algebraic Structures | V |
| Factors and Primes | V |
| Mathematical Systems | V |
| Systems of First Degree Equations in Three Variables | V |
| Radioactive Decay | V |

## SPANISH TRANSLATIONS

Some of the texts listed above have been translated into Spanish for use in Puerto Rico. Translations of the teachers' commentaries are also available for the first four titles.

| | |
|---|---|
| Matematicas Para El Primer Ciclo Secundario, Volumen I | V |
| Matematicas Para El Primer Ciclo Secundario, Volumen II | V |
| Matematica Para La Escuela Secundaria, Primer Curso de Algebra | V |
| Matematica Para La Escuela Secundaria, Geometria | V |
| Matematica Para La Escuela Secundaria, Matematica Intermedia | V |
| Matematicas Para La Escuela Secundaria, Introduccion Al Algebra De Las Matrices | V |
| Matematicas Para La Escuela Secundaria, Funciones Elementales | V |

Matematicas Para La Escuela Primaria,
Grado 6, Comentario ........ V
El Curso Conciso En Matematica Para Los
Profesores De Escuela Primaria ........ V

## STUDIES IN MATHEMATICS

The books in this series are all intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

Euclidean Geometry Based on
Ruler and Protractor Axioms ........ V
Structure of Elementary Algebra ........ V
Geometry ........ V
Concepts of Informal Geometry ........ V
Number Systems ........ V
Intuitive Geometry ........ V
Concepts of Algebra ........ V
Brief Course in Math for
Elementary School Teachers ........ V
Applied Mathematics in the High School ........ V
Mathematical Methods in Science ........ V
Brief Course for Junior High School
Teachers ........ V
Inservice Course for Primary School Teachers V
Introduction to Number Systems ........ V

## STUDY GUIDES IN MATHEMATICS

These consist of annotated bibliographies on various parts of mathematics, all bound in one pamphlet. They are intended for teachers wishing to study by themselves and also for those planning courses for teachers.

Study Guides in Mathematics ........ V
(Algebra, Calculus, Geometry, Number
Theory, Probability and Statistics, Digital
Computing and Related Mathematics,
Intermediate Mathematics)

## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

This course consists of thirty half-hour color films. The series is intended primarily for inservice elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementary school mathematics programs. The series is mathematical in content but no mathematical prerequisites are presumed. Studies in Mathematics, Vol. 9, is designed to accompany this filmed course.

The first sixteen of these films provide a suitable background in mathematics for teachers of

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grades K-3. The remainder, building on these, are concerned with mathematics normally taught in grades 4-6.

The distributor for these films is Modern Learning Aids, 3 East 54th Street, New York 22, New York. Distribution will be from the following five locations: 160 E. Grand Avenue, Chicago, Illinois 60611; 1411 Slocum Street, Dallas Texas 75207; 714 Spring Street, N.W., Atlanta, Georgia 30308; 444 Market Street, San Francisco, California 94105; and 315 Springfield Avenue, Summit, New Jersey 07901.

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were held to acquaint teachers with the contents and objectives of SMSG texts. Others were devoted to discussions of problems in mathematics education and the role of SMSG in attacking these problems.

Elementary School Mathematics .................... V
Orientation Conference for SMSG Experimental Centers .................... V
Orientation Conference for SMSG Elementary School Experimental Centers ...... V
Orientation Conference for Geometry with Coordinates .................... V
Future Responsibilities for School Mathematics .................... V
Mathematics Education for Below Average Achievers .................... V

## MISCELLANEOUS PUBLICATIONS

Very Short Course in Mathematics for Parents .................... V

This booklet is designed to give parents (and other interested persons) a chance to work through a small sample of "modern" mathematics and thus to see more clearly how and in what ways the "modern" treatment differs from the traditional.

Philosophies and Procedures of SMSG Writing Teams .................... V

Brief accounts of the philosophies developed by SMSG writing teams and the procedures used in preparing the SMSG texts.

SMSG: The Making of a Curriculum, by William Wooton .................... Y

This book records the activities of the school mathematics study group from 1958 to 1962.

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## ORDER INFORMATION

1. The Student's Text and the Teacher's Commentary must be listed separately on your order. The two parts of each set, however, cannot be ordered separately.

2. Orders will not be acknowledged unless specifically requested and an acknowledgment form is provided.

3. An educational discount of 30% will be given to schools; a courtesy discount of 10% will be given to libraries, teachers, and other persons directly associated with the field of mathematics.

4. All regular shipping charges by book post or by truck will be paid by Yale University Press. If you request any special shipping services (airmail, special delivery, etc.) the extra charges will be billed on your invoice.

5. We regret that we cannot supply free desk or examination copies.

6. As it takes longer to process an order during the rush period in July and August, we urgently suggest that you place your order well in advance of your needs. Orders for the new SMSG-Yale publications will be shipped on a first come, first served basis starting as soon as the books are available on July 1, 1966.

   Orders listing only Grade 7–12 texts and commentaries currently available will be processed as they are received unless a specific shipping date is requested.

7. Invoices will be sent when the books are shipped unless it is specifically requested that they be sent at a different time.

8. Returns may be made without prior permission, subject to the following conditions:

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   - Books must be returned to the shipping center indicated on the invoice, **not** to Yale University Press, New Haven.
   - Credit will be issued **only** for sets of books. We cannot accept parts of sets.
   - Our SMSG invoice number or numbers covering the purchase must accompany the shipment, preferably in an envelope attached to the outside of the parcel. (Your charge-back memo or other documents should be in the same envelope.)

9. All correspondence concerning orders should be addressed to:

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   School Mathematics Study Group
   92A Yale Station
   New Haven, Connecticut

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| | Book 1, Textbook | $1.50 | |
| | Book 1, Teacher's Commentary, Parts I and II | $3.00 | |
| | Book 2, Textbook | $1.50 | |
| | Book 2, Teacher's Commentary, Parts I and II | $3.00 | |
| | Book 3, Textbook, Parts I and II | $3.00 | |
| | Book 3, Teacher's Commentary, Parts I and II | $3.00 | |
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| | Student's Text, Parts I and II, per set | $3.00 | |
| | Teacher's Commentary, Parts I and II, per set | $3.00 | |
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**MATHEMATICS FOR JUNIOR HIGH SCHOOL**

| | | | |
|---|---|---|---|
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| ______ | Volume 2, Student's Text, Parts I and II, per set | $3.00 | ______ |
| ______ | Volume 2, Teacher's Commentary, Parts I and II, per set | $3.00 | ______ |

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**INTRODUCTION TO MATRIX ALGEBRA**

| | | | |
|---|---|---|---|
| ______ | Student's Text, per copy | $2.00 | ______ |
| ______ | Teacher's Commentary, per copy | $2.00 | ______ |

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| | | | |
|---|---|---|---|
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| ______ | Response Booklet | $1.50 | ______ |
| ______ | Teacher's Commentary | $1.50 | ______ |

**CALCULUS**

| | | | |
|---|---|---|---|
| ______ | Textbook, Parts I and II | | ______ |
| ______ | Teacher's Commentary, Parts I and II | | ______ |
| ______ | Textbook, Part III | | ______ |
| ______ | Teacher's Commentary, Part III | | ______ |

**SMSG: The Making of a Curriculum**

| | | | |
|---|---|---|---|
| ______ | per copy | $4.00 | ______ |

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CALCULUS PRICES

SEE PAGE 13

**Ship to:**

| | |
|---|---|
| Textbook, Parts I and II | $3.00 |
| Teacher's Commentary, Parts I and II | $3.00 |
| Textbook, Part III | $2.00 |
| Teacher's Commentary, Part III | $2.00 |

## SMSG ORDER FORM PUBLICATIONS

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367 South Pasadena Ave.
Pasadena, California

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|---|---|---|---|
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| | Euclidean Geometry Based on Ruler and Protractor Axioms (SM-2) | $ .90 | |
| | Structure of Elementary Algebra (SM-3) | $1.40 | |
| | Geometry (SM-4) | $2.75 | |
| | Concepts of Informal Geometry (SM-5) | $1.45 | |
| | Number Systems (SM-6) | $2.40 | |
| | Intuitive Geometry (SM-7) | $1.25 | |
| | Concepts of Algebra (SM-8) | $2.40 | |
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| | Conference on Future Responsibilities for School Mathematics (CR-5) | $ .25 | |
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| ______ | Junior High School Supplementary Unit, commentary (CJSU) | $ .65 | ______ |
| ______ | Essays on Number Theory, I (HSU-1) | $ .30 | ______ |
| ______ | Essays on Number Theory, II (HSU-2) | $ .50 | ______ |
| ______ | Development of the Real Number System (HSU-3) | $ .90 | ______ |
| ______ | Selected Units, Grade 4 (E-4150) | $ .75 | ______ |

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| ______ | Matematicas Para El Primer Ciclo Secundario, 2 Parts, Comentario (CJI-RS) | $2.00 | ______ |
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| | Matematicas Para La Escuela Secundaria, Geometria, 2 Parts, Comentario (CG-RS) | $2.00 | |
| | Matematicas Para La Escuela Secundaria, Matematica Intermedia 2 Parts (I-RS) | $2.00 | |
| | Matematicas Para La Escuela Secundaria, Funciones Elementales (E-RS) | $1.50 | |
| | Matematicas Para La Escuela Secundaria, Introduccion Al Algebra De La Matrices (A-RS) | $1.50 | |
| | Matematicas Para La Escuela Primaria, Grado 6, 2 Parts, Comentaria (SE-6) | $4.00 | |
| | El Curso Conciso En Matematicas Para Los Profesores De Escuela Primaria (SM-9) | $2.00 | |

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22, 23

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1. July 1, 1966 is the deadline for orders to be delivered as school opens.
2. Mark orders "For September Delivery."
3. For September delivery, a classroom set is the minimum order.

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| | | | |
|---|---|---|---|
| | **CALCULUS** | | |
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| | SP-3 | Teacher's Commentary for SP-1 and SP-2 | $ .25 | |
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| | What is Calculus About? | $ .99 | |
| | An Introduction to Inequalities | $ .99 | |
| | Geometric Inequalities | $ .99 | |
| | The Contest Problem Book | $ .99 | |
| | The Lore of Large Numbers | $ .99 | |
| | Uses of Infinity | $ .99 | |
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Random House, Inc.
239 Great Neck Road
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153 North Michigan Avenue
Chicago 1, Illinois

A reduced price edition is available from L. W. Singer Company, **but only to elementary and secondary schools.** Each volume in this paper bound edition is priced at $.99. An order form for school use is on the reverse side of this page.

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SCHOOL
MATHEMATICS
STUDY GROUP

# Newsletter No. 23

*August 1966*

*PANEL ON*
*SUPPLEMENTARY PUBLICATIONS*

R. D. Anderson (1962-66)
Louisiana State University, Baton Rouge
M. Philbrick Bridgess (1962-64)
Roxbury Latin School, Westwood, Mass.
Jean M. Calloway (1962-64)
Kalamazoo College, Kalamazoo, Michigan
Ronald J. Clark (1962-66)
St. Paul's School, Concord, N. H.
Roy Dubisch (1962-64)
University of Washington, Seattle
W. Eugene Ferguson (1964-67)
Newton High School, Newtonville, Mass.
Thomas J. Hill (1962-65)
Montclair State College, Upper Montclair, N. J.
L. Edwin Hirschi (1965-68)
University of Utah, Salt Lake City
Karl S. Kalman (1962-65)
School District of Philadelphia
Isabelle P. Rucker (1965-68)
State Board of Education, Richmond, Va.
Augusta Schurrer (1962-65)
State College of Iowa, Cedar Falls
Merrill E. Shanks (1965-68)
Purdue University, Lafayette, Indiana
Henry W. Syer (1962-66)
Kent School, Kent, Conn.
Frank L. Wolf (1964-67)
Carleton College, Northfield, Minn.
John E. Yarnelle (1964-67)
Hanover College, Hanover, Indiana

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## CONTENTS

REPRINT SERIES, 5

NEW SUPPLEMENTARY AND ENRICHMENT PAMPHLETS, 6

SECOND LIST OF INEXPENSIVE BOOKS FOR SUPPLEMENTARY USE, 7

ORDER FORM, 29

NOTE: A first list of inexpensive books appeared in Newsletter 17, March, 1964. Copies of this Newsletter are still available from

SMSG – Cedar Hall
Stanford University
Stanford, California 94305

The Panel on Supplementary Publications is pleased to announce a new series of pamphlets—the Reprint Series. Each pamphlet in this series will be devoted to a specific mathematical topic and will consist of reprints of articles on that topic which originally appeared in a number of different journals.

Professor William L. Schaaf is the editor of this series. Approximately a dozen such pamphlets are planned. The first three of them are now available.

### RS-1 THE STRUCTURE OF ALGEBRA

*Axioms in Algebra: Where Did They Come From?,* John K. Baumgart

*The Foundations of Algebra,* Charles Brumfiel

*A Simple Example of a Noncommutative Algebra,* Arnold Wendt

*A Noncommutative Algebra,* Clarence Perisho

### RS-2 PRIME NUMBERS AND PERFECT NUMBERS

*The Prime Numbers,* Howard W. Eves

*Mathematical Sieves,* David Hawkins

*The Factorgram,* Kenneth P. Swallow

*Perfect Numbers,* Constance Reid

### RS-3 WHAT IS CONTEMPORARY MATHEMATICS?

*The Nature of Mathematics,* Mina Rees

*Mathematical Inutility and the Advance of Science,* Carl B. Boyer

*Are Logic and Mathematics Identical?,* Leon Henkin

The following new pamphlets in the Supplementary and Enrichment Series are now available:

**SP-24.** Absolute Value

This pamphlet is essentially a reprint of selected portions from the SMSG texts *First Course in Algebra* and *Intermediate Algebra.*

**SP-25.** Teacher's Commentary for Absolute Value

**SP-26.** Mathematical Theory of the Struggle for Life

This pamphlet introduces the pupil to the notion of a mathematical model by which the solution of an actual problem can be attempted. It shows how one can start with a very simple case, which may not be realistic, and change the conditions to approach those which do exist.

**SP-27.** $1 + 1 = ?$

This pamphlet, written by Professor Francis Scheid, is designed for outside reading by high school students. Its objectives are 1) to exhibit a gamelike aspect of mathematics, 2) to show that "math is honest," and 3) to show that "math is useful."

The pamphlet should also be of considerable interest to persons who would like to know what "modern mathematics" is all about.

# SCHOOL MATHEMATICS STUDY GROUP SELECTED LIST OF INEXPENSIVE BOOKS FOR SUPPLEMENTARY USE IN MATHEMATICS

This list supplements the similar bibliography which appeared in the March 1964 NEWSLETTER, No. 17. Those books which are listed below are "inexpensive" in that they retail for $1.00 or less, an arbitrary cut-off point reflecting the policy adopted with respect to the earlier list. Most of the books noted below have been published since April 1963. The others are books which were overlooked in the preparation of the 1964 list or were not received in time for reading, annotating, and inclusion in that bibliography.

The primary consideration in deciding whether or not to list a particular book was its value to the *secondary school student* for enrichment or supplementary reading in mathematics. Therefore, books pertaining solely to pedagogy in mathematics or mathematics at a level or with a treatment of interest *only* to teachers have not been included.

Again we invite your suggestions as to other books which you feel should have been included and your comments concerning books we have included.

We continue the practice of annotating the list to make it easier for you to make a selection. A list of addresses of publishers is given at the end of the bibliography.

A symbol is used at the end of each annotation to designate as closely as possible the background required for that book, or the subject in which the book may be most useful. The following code is used:

Ar: Arithmetic
A-1: First-Year Algebra
A-2: Second-Year Algebra
A-3: Third-Year Algebra
G: Euclidian Geometry
T: Trigonometry
C: Calculus

An attempt has also been made to indicate the difficulty of the books by using a code which runs from 1 to 5, meaning easy to difficult, respectively. Although such a judgment is relative, and will also vary with the interests of the students using the book, it is hoped that such a classification will be of some use to fit the books to your needs.

## ALGEBRA, NUMBER SYSTEMS, ANALYSIS

ARCHER, A.: **Principles and Patterns of Numeration Systems;** Boston; Ginn; 1964; 72 pp.

This is a careful treatment of arithmetic using bases other than 10. The first 11 pages review the properties of the whole numbers under addition and multiplication, and these properties are shown in later pages to apply to arithmetic in other bases. In addition to developing methods for changing from one base to another and for performing the fundamental operations in other bases, the author discusses nomographs for the operations and also discusses other patterns and sequences. Exercises occur at frequent intervals, and the answers to these are found at the end of the booklet. This work would be most useful as a text supplement during the immediately pre-algebra years. (Ar); 1

BRISTOL, J.: **Graphing Relations and Functions;** Boston; Heath; 1963; 64 pp.

This booklet is written as a sequel to the author's *The Concept of a Function* (see March 1964 Newsletter) which belongs to this same series, *Thinking With Mathematics.* The first four sections do, as a matter of fact, review the basic material in the earlier booklet. Both approach the subject from the modern point of view. This booklet discusses inequalities (algebraically and graphically), asymptotes (vertical and nonvertical, linear and nonlinear), effect of odd and even powers of factors, addition of ordinates, and maximum and minimum points of the parabola. There are exercises, with those requiring a background of trigonometry starred, and the booklet can be used either as a supplementary classroom text or for individual self-study. (A-2, A-3); 3

COHN, P. M.: **Linear Equations;** New York; Dover; 1958; 75 pp.

The author approaches the problem of solving the general system of $m$ linear equations in $n$ variables, first through vectors, then by means of matrices, and, in the final chapter, by means of determinants. In the process, the reader is exposed to a good deal of the theories of vectors and vector spaces, matrices, and determinants. Although the primary objective is the method of solution of systems, there is a sufficient emphasis upon properties and proofs to provide the reader with more than a casual understanding of these methods. In the chapter on general systems, appeal is made to the intuition through a set of diagrams indicating the possibilities for solutions in the three-dimensional case. Each of the five chapters ends with a set of exercises, the answers to many of which appear at the end of the booklet. This short textbook would serve as enrichment for the ambitious and energetic twelfth-grader who is interested in the subject matter and who is willing to spend the time required for a careful study. (A-3); 5

GROSSMAN, I. and MAGNUS, W.; **Groups and Their Graphs;** Syracuse; Singer; SMSG; 1964; 195 pp.

The authors of this book start with a careful development of the definition and properties of groups. Although the presentation is clear, considerable amounts of concentration are demanded on the part of the reader. Cayley diagrams (graphs) are used to help the reader grasp the idea of the group structure. Group generators and relations, subgroups, mappings, permutation groups, homomorphism and isomorphism are included among the topics covered. This is self-study material well-worth the necessary effort to an ambitious 11th or 12th grader who wishes to delve more deeply into the concepts of modern algebra than is done in usual classroom work. (A-3); 5

HILTON, P. J.; **Differential Calculus;** New York; Dover; 1958; 56 pp.

This would be a good booklet for the able and ambitious twelfth-grader who is not enrolled in a calculus course but who wishes to gain an insight into the basic notions and an overview of the uses of the Differential Calculus. Although appeal is made frequently to the intuition, the development of the theory is deductive and formal. By the end of Chapter II the formulae for the differentiation of all elementary functions have been developed. In Chapter III the Mean Value Theorem and Taylor's Theorem are deduced, and examples of their application are given. The booklet ends with Newton's Method for the approximation of real roots of polynomial equations. Each chapter is provided with a set of exercises with answers given at the end of the booklet. (A-3, T); 5

LEDERMANN, W.; **Complex Numbers;** New York; Dover; 1960; 62 pp.

In Chapter One, after a brief intuitive discussion of the extension of the number system from the natural numbers to the reals, the author defines complex number and proceeds to develop the algebraic theory. Chapter Two introduces the geometric representation by means of the Argand diagram and proceeds to a development of complex numbers represented as vectors. The polar form of the complex number is then discussed, and the theorems for multiplication and division of complex numbers in polar form are then proved, as is DeMoivre's Theorem. In an informal way, the necessary infinite series are brought in at this point in order to develop the important Euler's Formula relating the sine and cosine functions to the exponential function. Chapter Three uses the results of Chapter Two in a discussion of the roots of unity and also to prepare the way for Chapter Four, Elementary Functions of a Complex Variable. This short textbook would provide enrichment for the mathematically mature twelfth-grader who desires to investigate Complex Numbers beyond the point usually reached in high school classes and who is ready to do the concentrated study necessary. (A-3, T); 5

Matthews, G.; **Matrices 1**; Boston; Houghton Mifflin; 1964; 80 pp.

The author motivates his discussion of the subject matter by first introducing it through an application to coding and decoding. The multiplication of 2 × 2 matrices is involved in the decoding as is the determination of the inverse of a 2 × 2 matrix, the student being led to discover the method. The noncommutativity of matrix multiplication is also brought out in this first chapter. Matrix applications to tabulation, solution of simultaneous equations, and to the study of vectors and transformations are also covered. Much of the discussion is limited to 2 × 2 matrices. Secondary students at all levels would find excellent supplementary and enrichment material here, although some previous knowledge of geometry and trigonometry would be required for a cover-to-cover understanding of this booklet. Ample exercise work is provided. (A-1, A-2, A-3, G, T); 3

Matthews, G.: **Matrices 2**; Boston; Houghton Mifflin; 1964; 79 pp.

This is a sequel to *Matrices 1* and commences with a more thorough treatment of the application of matrices to geometric transformations as introduced in the first booklet. The second chapter is concerned with the structure of a group of transformations represented in matrix form, and the notion of isomorphism is brought in here. The third chapter introduces *Probability Matrices and*

*Eigenvalues*, the motivation being a probability problem involving the power of a matrix which in turn involves finding eigenvalues and eigenvectors. This is more sophisticated material than appears in the first booklet. It would provide excellent enrichment material at the higher secondary levels. There is a good amount of exercise work. (A-3, G, T); 3

MUNKRES, J. R.; **Elementary Linear Algebra;** Reading; Addison-Wesley; 1964; 42 pp.

The author discusses in considerable detail those basic definitions and theorems of linear algebra relevant to the study of the general system of k linear equations in n unknowns. Vector spaces and subspaces, spanning sets, linear independence, bases for and dimensions of vector spaces and subspaces, and row operations on matrices are some of the important ideas covered. Determinants and function spaces are the subjects of the last two sections. Understanding of this booklet requires some detailed familiarity with vectors as studied in physics or calculus. Only in the section on function spaces is knowledge of elementary calculus assumed. This is enrichment material for an able and ambitious 12th grader, whether or not he is studying calculus. (A-3, G); 5

SPRECKELMEYER, R.; **The Integers;** Boston; Heath; 1964; 63 pp.

The author systematically develops the integers defined as sets of ordered pairs of whole numbers. The idea of equivalence relation is developed and the proof given that equality of the ordered-pairs satisfies the definition of such a relation. The definitions of addition and multiplication are given for these ordered-pairs, and the properties of integers under these operations are then carefully developed, as are the properties of order. Although the treatment is abstract, there are plenty of examples given, and appeal to the intuition is made wherever it is helpful in adding to the clarity of the presentation. This is good supplementary material at the 2nd or 3rd year algebra level. (A-2, A-3); 2

SPRECKELMEYER, R.; **The Real Numbers;** Boston; Heath; 1964; 54 pp.

Since the development of the reals is quite sophisticated for the potential readers of this booklet, the author states early that the reader "would be given only an artist's concept, in depth, of the structure of this vastly important system." The approach is through sequences of rationals and the notion of convergence, and in the process the epsilon definition of limit of a sequence is established. A real number is then defined as an equivalence class of convergent sequences, and there follows a discussion of the four fundamental operations with reals and the properties of order, all in terms of this definition. The completeness property is also developed and stated in terms of real limits of convergent real sequences. Although this is a booklet the student will find challenging, it is an excellent introduction to some of the concepts with which he must come to grips when he studies calculus. (A-2, A-3); 5

SPRECKELMEYER, R.; **The Complex Numbers;** Boston; Heath; 1965; 49 pp.

This booklet develops the field of complex numbers as ordered-pairs of real numbers. Powers and roots of complex numbers are developed algebraically before polar form and DeMoivre are introduced. The final chapter draws the connection between complex numbers and the geometry of vectors and includes a discussion of mathematical induction and the proof of DeMoivre's Theorem. As in the other pamphlets in this series, *Thinking With Mathematics,* the reader's way is generously assisted with examples. This is good supplementary material for class or out-of-class work. (A-3, T); 3

THOMAS, G. B., Jr.; **Limits;** Reading; Addison-Wesley; 1963; 51 pp.

This is a pamphlet-size text designed, in the words of the author's preface, "as a prelude to calculus, or a supplement to a course on elementary functions, or a supplement to a calculus course." After a brief discussion of the limit idea, using familiar examples, the epsilon definition of limit of a sequence is developed and the consequent limit theorems are then proved. There is a discussion of monotone sequences, and the convergence of bounded monotone sequences is proved. Similar treatment is then given to limits of functions that are not sequences. Continuity is defined, but no general discussion follows. The book concludes with applications involving slope of a tangent, instantaneous velocity, and area under a curve. (A-3, T); 4

YARNELLE, J. E.; **Finite Mathematical Structures;** Boston; Heath; 1964; 66 pp.

This is another of the series, *Thinking With Mathematics,* and is written in the same informal but precise and conceptually sound manner. The author starts with a discussion and definition of a number field using modular arithmetics with prime moduli as examples. There is a thorough discusion of groups on an elementary level with a good selection of examples. Rings, integral domains, and Boolean Algebra are also discussed. As is the case with the other booklets in this series, this one is designed for supplementary and enrichment work in or out of class. (A-1, A-2); 2

YARNELLE, J. and SPRECKELMEYER, R.; **The Rational Numbers;** Boston; Heath; 1965; 73 pp.

This is a systematic development of the ordered field of rationals defined as equivalence classes of ordered-pairs of integers, and it starts with a short review of the similar development of the integers given in Mr. Spreckelmeyer's *The Integers.* The motivation is the desirability of extending the number system to gain additional properties while preserving those of the integers. Proofs are given, and there are enough exercises to establish the ideas and methods. The notion of density is included as is a treatment of equivalence relations and the partitioning of a set into equivalence classes by such a relation. Although the accent is upon the abstract development of the structure of the rationals, the authors tie in the results with the ordinary rules for working with fractions. At the same time they make the point that only through the abstract development are those rules established upon a solid logical foundation. This is excellent supplementary material for 2nd or 3rd year algebra students and it could be used as a text. (A-2, A-3); 2

YARNELLE, J. E.; **An Introduction to Transfinite Mathematics;** Boston; Heath; 1964; 65 pp.

This is an informal treatment of the subject of transfinite cardinals. Starting with the notions of 1-1 correspondence, counting, cardinality, etc., the reader is introduced to aleph-null, the cardinal number of a denumerably infinite set. The arithmetic of cardinals is then discussed in preparation for the discussion of uncountable infinities. It is shown, by means of the idea of height of a polynomial, that the algebraic reals are denumerable. The cardinal number of the continuum is used as the point of departure for the general discussion of "larger" cardinals. Any student with a strong algebra background (two years) and who is willing to do the careful thinking required to follow this book, has much to gain in enrichment by a study of it. (A-2); 4

Young; **Limits and Limit Concepts**; Boston; Ginn; 1964; 72 pp.

"The purpose of this text is to provide a firm support for a future calculus course." (Author's preface) After a treatment of limits on an informal and intuitive level, based upon examples which should already be familiar to the reader, the formal definition of limit of a function is given and explained. The usual theorems are then stated and proved. There follows the formal treatment of continuity, and a chapter is also devoted to sequences and series with the proofs of convergence theorems, short of a complete formal treatment of power series. The last chapter is devoted to a discussion of area under a curve. (A-3, G, T); 4

## GEOMETRY

GLICKSMAN, A.; **Vectors in Three-Dimensional Geometry;** Washington; NCTM; 1961; 47 pp.

Only Part III deals with vector analysis in three dimensions. Parts I and II present preliminary results in synthetic and analytic solid geometry, while Part IV gives derivations of several volume formulae, the treatment depending upon some familiarization with the definite integral. Part V consists of a short discussion of Euler's formula (intuitive) and regular polyhedra. The various parts of the booklet would be useful as enrichment material and text supplementation in 12th grade mathematics courses. (A-2, A-3, G, T); 3

IVINS, W. M., Jr.; **Art and Geometry; A Study in Space Intuitions;** New York; Dover; 1964; 113 pp.

Although remarks on the back cover of this re-publication (first published in 1946) refer to this as a "controversial study" – perhaps because the accomplishments of the ancient Greeks are not given the traditional reverence – it is good supplementary reading for a mature eleventh or twelfth grade student. The interplay of geometry and art, the influence of the geometry of a period upon its art, and the history of the development of mathematical perspective and projective geometry are all discussed at length in this volume. (A-2, G); 2

MANNING, H. P.; **Introductory Non-Euclidian Geometry;** New York; Dover; 1963; 95 pp.

This is a reprint of a book published originally in 1901. Hence, the reader who is versed in some of the relatively recent refinements in the language and notation of geometry will find the statements of theorems and the phraseology used in this book a little on the "old fashioned" style. However, for the mathematically mature and ambitious eleventh or twelfth grader, a reading of this work will provide an introductory insight from the classical point of view into the subject of Non-Euclidian Geometry. The first three chapters lead, in a semi-intuitive treatment, from the theorems which hold true for both Euclidian and Non-Euclidian Geometry, through a discussion of both the hyperbolic and elliptic branches of the latter. The fourth chapter, "Analytic Non-Euclidian Geometry," requires more mathematics than will ordinarily be commanded by the secondary student, but the first three do not require mathematics beyond a course in trigonometry. The book concludes with a short history of the development of the subject. (A-3, G, T); 4

## COMPUTING MACHINES

DARNOWSKI, V. S.; **Computers — Theory and Uses;** Washington; National Science Teachers Association; 1964; 108 pp.

This is a booklet written to provide an introduction to computing machines and their implications. It covers a wide range of aspects including the nature and uses of computers, the history of their development, the principles of construction and operation, the principles of flow charting and programming, and a comparison of digital and analog computers. Appendices contain a glossary of terms, an introduction to the binary system, and descriptions of some presently used input, storage, and output media. The booklet can be used as supplementary reading or as a text for a short descriptive course on computers at any secondary level. (A-1); 1

HALACY, D. S., Jr.; **Computers, the Machines We Think With;** New York; Dell; 1964; 258 pp.

This is a complete account of the history, development, nature, and uses of the high-speed computer, including a comparison of the digital and analog types, as to history, development and use. There is a discussion of the binary numeration system and its application to the digital computer, as well as a short treatment of the application of Boolean Algebra to switching. This book would make good outside reading of a descriptive nature to supplement a student's study in a course on computers, or to motivate a student for further, more technical study of the computer on his own. (A-2); 1

LOVIS, F. B.; **Computers 1;** Boston; Houghton Mifflin; 1964; 64 pp.

This is an introduction to the electronic digital computer, its nature, design, and uses, and includes a rather thorough introduction to binary arithmetic. It would serve as supplementary reading for secondary students about to embark on a full-scale course in computers, as well as outside reading of general interest to secondary students at any level. (A-1, A-2); 1

LOVIS, F. B.; **Computers 2;** Boston; Houghton Mifflin; 1964; 70 pp.

This booklet continues and extends the discussion in *Computers 1*. Chapter 1 is devoted to a discussion of the different types of computer input and output devices. Binary multiplication and division are the subject of Chapter II, while the reader is introduced in Chapter III to flow charting and programming. The fourth chapter includes not only examples of the usual elementary sort for making clear the nature of linear programming, but includes an interesting problem (involving some knowledge of matrices) of distribution and an iterative solution ideally suited to the computer. Chapter V is devoted to a discussion of uses of computers. This booklet would serve as supplementary or introductory material for students enrolled in a computer course or for students who simply are interested in the general topic. (A-1, A-2); 3

## HISTORY

Aaboe, A.; **Episodes From the Early History of Mathematics;** Syracuse; Singer; SMSG; 1964; 133 pp.

The author concentrates his attention upon four significant episodes in the development of mathematics in antiquity: the Babylonian number system and arithmetic; early Greek mathematics and Euclid's construction of the regular pentagon; three samples of Archimedean mathematics, namely, his trisection of an angle, construction of the regular heptagon, and his method of determining certain volume and area formulae; and Ptolemy's work on his table of chords as presented in *The Almagest*. The treatment follows the ancient texts only to the extent that the proofs and details are made historically meaningful. This is good enrichment material, particularly for geometry students. Problem work is provided for the more energetic readers. (A-2, G, T); 3

Freitag, H. and Freitag, A.; **The Number Story;** Washington; NCTM; 1960; 76 pp.

This is a treatment of the development of number and numeration systems from antiquity to the present day. It is not only a history but also a dissertation on number systems and their properties. It contains discussions of such matters as denumerability, Peano's postulates, methods of computation, continued fractions, and ideas from number theory. It is thorough and precise without being too rigorous. It is primarily useful as enrichment material from the point of view of the history of mathematics and mathematics itself. (A-2, A-3); 3

Marks, R. W. (editor); **The Growth of Mathematics From Counting to Calculus;** New York; Bantam; 1964; 217 pp.

This is an anthology of writings organized in two parts. Part One deals with the meaning, nature, and foundations of mathematics and contains papers, essays and other writings by Whitehead, Russell, Peirce, and d'Abro. The second part traces the development of mathematics from the Egyptians through the present day by means of the writings of Cajori, Sarton, Bell, and Morris Kline. It would be useful as general reading material for secondary students interested in the history of mathematics and in acquiring some knowledge of the philosophy of mathematics. (A-2, G); 2

Marks, R. W. (editor); **Space, Time, and the New Mathematics;** New York; Bantam; 1964; 295 pp.

This is an anthology of the writings of such men as Fermat, Pascal, Boole, Galileo, Einstein, Wiener, Poincaré, and Gamow. It is organized in 4 parts: Part One: Mathematics of Chance and Logic; Part Two: Mathematics Pictures the Physical World; Part Three: The Logical Theory of Automata; Part Four: The Future of Mathematics. This book would serve as reference material for the relatively mature (intellectually) student who may wish to delve into the philosophical implications of modern science and mathematics and for the student who may wish to read of the development of a subject from the point of view of the men who developed it. (A-3, G, T); 3

Smeltzer, D.: **Man and Number;** New York; Collier; 1962; 114 pp.

In this booklet the history of numbers, numeration, and calculation are traced from the limited sense of number among the primitives to the invention of logarithms and the present decimal system. The emphasis is on number symbolism, numeration systems, and calculation methods rather than upon the structure of the number system and its general properties. This is a booklet primarily of interest to students who wish to study the history of the idea of number. (Ar, A-1); 1

Wolff, P.; **Breakthroughs in Mathematics;** New York; New American Library (Signet); 1963; 285 pp.

This is an anthology of excerpts from the works of 9 famous mathematicians from Euclid to Russell, each of whom was responsible for some significant breakthrough in the development of mathematics. The purpose, from the author's introduction: ". . . we want to afford the reader . . . an opportunity to see great mathematical minds at work." The other famous men, not in historical order: Lobachevski, Descartes, Archimedes, Dedekind, Euler, LaPlace, Boole. Each chapter has two parts, the first of which is the excerpt itself and the second of which is the author's commentary. (A-2, G); 2

## MISCELLANEOUS

BAILEY, C. A. R.; **Sets and Logic 1;** Boston; Houghton Mifflin; 1964; 96 pp.

From the author's preface: "This booklet has two main purposes: (i) to show that set language is applicable to large areas of the traditional mathematics course, and (ii) to emphasize that mathematics is concerned with a far wider field than the traditional topics of number and space." These goals are well-realized in this booklet which covers the ground from the basic set notation, definitions, and properties to a discussion in the last chapter of set algebra. Also treated, making full use of the unifying concept of sets, are number systems and inequalities, relations and functions, logic, and Boolean Algebra. The booklet has a good number of sets of exercises and is most suitable for supplementary or enrichment, class or individual study at all levels of secondary mathematics. (A-1, A-2, A-3, G); 2

BAILEY, C. A. R.; **Sets and Logic 2;** Boston; Houghton Mifflin; 1964; 79 pp.

This is a sequel to *Sets and Logic 1* extending the treatment of Boolean Algebra introduced in the first booklet and introducing the concept of mathematical structure. The first two chapters apply Boolean Algebra to switching and circuitry. The third chapter is an introduction to the theory of probability using the sample space approach. Chapter IV, "More Relations," extends the discussion of relations found in the first booklet making use of the idea of Cartesian product. The concept of a mapping is introduced in this chapter, as are the ideas of equivalence relations and classes, order relations, and fields. Basic notions of symbolic logic are the subject matter of Chapter V. This is good supplementary or enrichment material for class or individual study at all levels of secondary mathematics. Ample exercise work is provided. (A-1, A-2, A-3, G); 2

BARNETT, I. A.; **Some Ideas About Number Theory;** Washington; NCTM; 1961; 71 pp.

This booklet gives a survey of topics in elementary number theory and should serve to stimulate able secondary students to probe more deeply into the subject. Rigorous, detailed proofs are omitted, and in most cases an indication only of the idea behind the proof is given, followed usually by examples giving verification. Topics covered include the basic ideas concerning primes, composites, and divisors, with the associated number-theoretic functions, and some of the more important results proved by such famous mathematicians as Fermat, Euler, and Lagrange. There is discussion of some of the unsolved problems, such as the Goldbach Conjecture and Fermat's Last Theorem. The application of number theory to polygon constructibility, congruences, Diophantine equations, and the generalization to Gaussian and other complex integers are also included. This booklet would serve as good enrichment material for 11th or 12th graders. (A-3, G); 3

BRISTOL, J.; **An Introduction to Linear Programming;** Boston; Heath; 1963; 66 pp.

This unit on linear programming provides excellent enrichment material for class or individual use to follow up on an initial study of graphs of simultaneous linear inequalities. There are nine pages of examples of linear programming problems, necessarily trivial, but thoroughly establishing the basic principles. These include an example involving several constraints on three variables which goes a long way toward indicating the complexities when more than two variables are involved and which serves to motivate the discussion of Matrix Algebra in the Appendix. This Appendix does not dwell on matrix theory, but establishes the definitions for addition and multiplication and the methods for finding inverses for use in solving simultaneous equations. These methods are then used to find the feasible points for a solution to a linear programming problem. (A-2, A-3); 3

CLIFFORD, P., KEIFFER, M. and SOBEL, M.; **Sets, Probability, and Statistics, the Mathematics of Life Insurance;** New York; Educational Division, Institute of Life Insurance; 1964; 35 pp.

The first three chapters of this booklet are devoted to a semiformal treatment of sets, sample spaces, and the elementary ideas of probability, use being made of the set approach to this latter topic. Chapter 4 deals with the statistical, or empirical, method of determining probabilities, and the use of the mortality table is naturally introduced at this point. Chapter 5 continues the discussion of the mortality table and its use in determining insurance premium rates. The notions of compound interest and present value are then brought in, preceded by an explanation of the fact that the interest earned through investment of the money paid in, in premiums, reduces the premium rate. The eighth and final chapter is concerned with the various types of life insurance designed to meet the varying needs of individual policy holders. This is material for late Junior High or early Senior High students and would serve to stimulate interest in mathematics in general. It gives a clear indication of the practical uses to which the ideas of sets and probability can be put. There are frequent sets of problems making the booklet suitable for supplementary class use or individual study. (Ar, A-1); 1

JOHN, L.; **Topics in Mathematics for Elementary School Teachers**; Washington; NCTM; 1963

This is a series of eight booklets, average length about 50 pages, prepared by a summer writing group coordinated by Lenore John. The entire series comprises the eight chapters of the 29th Yearbook of the NCTM, but each title is still available in pamphlet form. The titles are self-explanatory: 1. *Sets;* 2. *The Whole Numbers;* 3. *Numeration Systems for the Whole Numbers;* 4. *Algorithms for Operations With Whole Numbers;* 5. *Numbers and Their Factors;* 6. *The Rational Numbers;* 7. *Numeration Systems for the Rational Numbers;* 8. *Number Sentences.* Although these are written primarily for teachers of elementary mathematics, they and the exercises therein would be usable as materials of a supplementary nature for junior high school and elementary algebra students. (Ar); 1

MARKS, J. L. and others; **Sets, Geometry, Other Systems**; Boston; Ginn; 1962; 64 pp.

This is a write-in text for supplementary use in pre-algebra junior high classes. Topics covered: language and notation of sets, union and intersection, sets of points, lines, segments, rays, angles, modular arithmetic, and arithmetic using bases other than 10. (Ar); 1

MARKS, J. L. and others; **Sentences, Properties, Probability**; Boston; Ginn; 1963; 64 pp.

This is a write-in text for supplementary use in pre-algebra junior high classes. True and false sentences, open sentences, the number line, solution sets, ordered pairs, graphing of sentences, the properties of the numbers of arithmetic, and the basic notions of probability are the topics covered. (Ar); 1

MAXWELL, E. A.; **Fallacies in Mathematics**; Cambridge; Cambridge University Press; 1959; 95 pp.

In order to appreciate this booklet in its entirety the reader should have some knowledge of calculus and analytic geometry, as well as a small amount of complex geometry. However, there is sufficient material well within the grasp of the student who has had secondary mathematics through geometry to make this work interesting and worthwhile. The proof that all triangles are isosceles is treated in no less than four different ways: one, by purely synthetic geometry; two, trigonometrically and algebraically; and one, by means of trigonometry and differentiation. Fallacious proofs are presented first and later analysed, giving the reader a chance to try his own hand at discovering the fallacies. Examples are taken from all branches of secondary mathematics plus analytic geometry and calculus. (A-3, G, T, C); 3

NIVEN, I.; **Mathematics of Choice: How to Count Without Counting;** Singer (SMSG); 1965; 202 pp.

This is a book for the student who is interested in going beyond the treatment of "Permutations and Combinations" which usually precedes an introduction to probability. The first three chapters establish the basic principles of combinatorial analysis which are then applied in succeeding chapters to, among other matters, the number of solutions over the non-negative integers of linear equations with unit coefficients, the inclusion-exclusion principle, the number of partitions of an integer, the distribution of objects in cells, and configuration problems. There is a chapter devoted to Mathematical Induction and the sigma and pi notations for sums and products, respectively. An introduction to combinatorial probability appears in Chapter 5. This is essentially a problem book, the presentation of each idea being followed up immediately by a set of exercises designed to establish the principle in the reader's mind. Answers or solution outlines to the problems appear at the end of the book preceded by a section of miscellaneous problems. This work demands, especially after the first three chapters, concentration and the willingness to use pencil and paper liberally. (A-1, A-2, A-3); 4

PEDOE, D.; **The Gentle Art of Mathematics;** New York; Collier; 1963; 159 pp.

This is an entertaining, easy-to-read book which takes the reader through mathematical topics of interest in the modern day: applications of binary and ternary numeration to games and problems, probability, infinity, Boolean Algebra and symbolic logic, ideas in topology, algebraic structure, and infinite series. The next to last chapter discusses and compares the three schools of mathematical philosophy: formalism, intuitionism, and logisticism. The final chapter attempts to answer the question, "What is Mathematics?" Although the treatment is largely informal, the theoretical basis of each subject is clearly developed. This is good "outside" reading for students who have had 2 years of algebra and some geometry. (A-2, G); 3

POLYA, G.; **How to Solve It;** New York; Doubleday Anchor; 1957; (Second Edition); 253 pp.

This book is for the student who is interested in probing into the processes of thought whereby solutions to problems are discovered and who is bent upon improving his approach to problem solving in mathematics, as well as in general. These processes constitute a branch of learning called "heuristic." By far the largest section of the book, Part III, is called a "Short Dictionary of Heuristic" in which there are lengthy discussions of matters such as analogy, auxiliary elements and problems, definition, generalization and specialization, mathematical induction and indirect proof. There are many examples, largely involving geometric materials, and the book concludes with about twenty pages of "Problems, Hints, Solutions." (A-3, G); 2

REYNOLDS, J. A. C.; **Shape, Size, and Place;** Boston; Houghton Mifflin; 1964; 68 pp.

As the author writes in his preface: ". . . our title might well have been 'Bits and Pieces.'" This booklet contains a variety of subject matter, all of which would make good material for supplementary study and enrichment for students at the earlier levels of secondary school. Coordinate geometry, including an introduction to reflections and rotations in the plane, graphs of equations and inequalities, including elementary linear programming, Cartesian product sets, and elementary ideas of topology are all presented in this booklet. (A-1); 2

ROSENTHAL, E. B.; **Understanding the New Mathematics;** Greenwich; Fawcett (Crest); 1965; 240 pp.

This is a book which has been written with the intention of explaining to adults the "new math" — not alone the general idea behind and the reasons for the recent curriculum changes, but the mathematics itself. Material illustrating both the new approach and the new subject matter in elementary and secondary schools is included. Topically, much of the material will be found in the textbooks of courses in elementary algebra and geometry. Its value to the student is a matter of enrichment (e.g., linear programming, application of sets to logic, Boolean Algebra, elementary notions of topology) and the possibility that he might gain some understanding of the contemporary scene in school mathematics as it relates to the "old days" of his parents – i.e., the historical significance of what he is doing. There are frequent problem sections with answers and explanations. (A-1, A-2, G); 2

SHERLOCK, A. J.: **Probability and Statistics;** Boston; Houghton Mifflin; 1964; 103 pp.

This booklet introduces the ideas of statistical analysis and probability. A discussion of the various methods of representing data is followed by a treatment of statistical averages and indices. The basic probability ideas are treated in a largely intuitive, non-set-theoretic way. The chapter devoted to frequency distributions in general is followed by a chapter entitled "The Binomial Distribution, Sampling, and Significance Tests." The final chapter treats regression and correlation. This booklet, which has a good quantity of exercise work, can be used for enrichment material in connection with a class unit on probability, as a class unit itself, or as supplementary material for individual study on the part of an interested student. (A-2); 2

WIENER, N.: **The Human Use of Human Beings: Cybernetics and Society;** Garden City; Doubleday Anchor; 1954; 199 pp.

This book is written for mature adults or unusually mature secondary students at roughly the twelfth-grade level. It is a presentation adapted to the lay public of the ideas in this famous author's more technical book, *Cybernetics.* This new science attempts to reach an understanding of society through a study of the messages and communication facilities which belong to it, ". . . messages between man and man, man and machine, and machine and machine." Although there is little direct and specific appeal to the reader's mathematical talent or interest, it is timely reading and should be recommended particularly to the mature student who has interest in the social implications of the Second Industrial Revolution which is being wrought by the rapid development of automation and the high-speed computer. (A-3); 4

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# Newsletter No. 26

*April 1967*

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# CONTENTS

IMPORTANT ANNOUNCEMENT
  CHANGE IN DISTRIBUTOR, 5
  PRICE CHANGES, 5

BRIEF DESCRIPTIONS OF SMSG PUBLICATIONS, 5

ORDER FORMS, 17

# IMPORTANT ANNOUNCEMENT

## CHANGE IN DISTRIBUTOR

Beginning July 1, 1967, the SMSG texts hitherto distributed by the Yale University Press will be distributed by A. C. Vroman, Inc. The Yale University Press will continue to receive orders for the textbooks it now distributes until May 31, 1967. Orders for delivery after July 1, 1967, should be addressed to A. C. Vroman using the order form at the back of this newsletter.

## PRICE CHANGES

The list prices of some SMSG publications have been increased, in part to reflect the discount policy stated on page 15 and in part to reflect recent changes in the cost of production. The new prices are indicated on the order form at the back of this newsletter.

## BRIEF DESCRIPTIONS OF SMSG PUBLICATIONS

### HIGH SCHOOL TEXTBOOKS

These texts are designed for average and above average students in a college preparatory program. The *Programed Algebra* text has a separate response booklet so the text is reusable. *Geometry With Coordinates* is designed as an alternative to *Geometry*, putting more emphasis on analytic geometry. *Matrix Algebra* and *Analytic Geometry* are intended for students who have completed the prerequisites for calculus but wish to postpone study of this subject until college.

*Algorithms, Computation, and Mathematics* is a one semester course intended for the last year of high school. It is concerned with mathematical concepts which are fundamental to computer science. The text itself does not require a specific programming language and two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL.

*Calculus* appears in three parts. The first two together constitute a normal one year course and cover, for example, the CEEB advanced placement syllabus. Part three, which is available separately, takes up supplementary topics, mainly applications of calculus to the physical sciences.

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Mathematics for Junior High School, Volume II

## TEXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in the texts for grades 7-9 listed above. However, the level of reading difficulty has been reduced to make them more suitable for students who are slightly below average in ability. It is expected that such students will proceed through these materials at a reduced rate.

Each text is accompanied by an extensive teacher's commentary.

Introduction to Secondary School Mathematics, Volume I
Introduction to Secondary School Mathematics, Volume II
Introduction to Algebra

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4-6 presuppose a conventional program through grade 3. The emphasis in all these texts is similar to that of the Junior High School texts.

In the Teacher's Commentary for each text all pages of the student text are reproduced. For Kindergarten there is only a teacher's book.

Mathematics for the Elementary School, Book K (Teacher's Commentary only)
Mathematics for the Elementary School, Book 1
Mathematics for the Elementary School, Book 2
Mathematics for the Elementary School, Book 3
Mathematics for the Elementary School, Grade 4

Mathematics for the Elementary School, Grade 5
Mathematics for the Elementary School, Grade 6

## MATHEMATICS FOR CULTURALLY DISADVANTAGED CHILDREN

Special editions of the teacher's commentary for kindergarten and for grade one as well as the student work book for grade one have been prepared for use with culturally disadvantaged children. Studies in Mathematics, Volume 13 (listed below), is designed for use in in-service courses for teachers planning to use these materials.

Mathematics for the Elementary School, Book K, Special Edition
Mathematics for the Elementary School, Book 1, Special Edition

## SUPPLEMENTARY MATERIALS

A variety of booklets is available. Their common characteristic is that each requires less than a full academic year.

The first three of the following booklets use simple experiments from physical science to introduce and motivate mathematical ideas. They are designed for grades seven, eight, and nine. The later booklets do not presuppose study of the earlier ones.

The fourth booklet below parallels *MATHEMATICS THROUGH SCIENCE*, Part 2, but uses simple experiments from biological science rather than physical science.

Mathematics Through Science, Part 1
Mathematics Through Science, Part 2
Mathematics Through Science, Part 3
Mathematics and Living Things

The following three booklets contain material from the preliminary version of the texts for junior high school and are designed to allow a teacher to cover some of the ideas in these texts without being committed to a full two-year program.

Junior High School Mathematics Units, Number Systems
Junior High School Mathematics Units, Geometry
Junior High School Mathematics Units, Applications

The next booklet contains material not included in the textbooks for grades seven and eight and is designed for abler students.

Junior High School Supplementary Unit

The next two booklets are designed for outside reading by students in grades nine through twelve.

Essays on Number Theory I
Essays on Number Theory II

The following booklet, based on the first chapter of "Intermediate Mathematics," provides a review of the structural properties of the real number system and of its subsystems.

Development of the Real Number System

The last booklet in this list contains selected chapters from the fourth grade text and is designed for students starting the SMSG program with the fifth grade text.

Selected Units, Grade 4

## PROBABILITY UNITS

Two pamphlets on probability have been prepared, one for the primary grades and one for the intermediate elementary school grades. A classroom set of spinners is available for use with each of these.

A programmed short text on probability for use in junior high school is also available and a second programmed text, presupposing the first and probably more suitable for senior high school, is also available.

Probability for Primary Grades
Probability for Intermediate Grades
Introduction to Probability, Part I
  Basic Concepts
Introduction to Probability, Part II
  Special Topics

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets are designed to allow teachers to try short modern treatments of particular mathematics topics in class. Some, however, are designed for independent study or enrichment. Teacher's commentaries are available for some of these.

Functions
Circular Functions
The Complex Number System
The System of Vectors
Non-Metric Geometry
Plane Coordinate Geometry
Inequalities
Numeration
Algebraic Structures
Factors and Primes

Mathematical Systems
Systems of First Degree Equations in
  Three Variables
Radioactive Decay
Absolute Value
Mathematical Theory of the Struggle for Life
$1 + 1 = ?$

## REPRINT SERIES

Each of these pamphlets is devoted to a particular topic in mathematics and contains reprints of articles selected from a variety of journals.

The Structure of Algebra
Prime Numbers and Perfect Numbers
What is Contemporary Mathematics?
Mascheroni Constructions
Space, Intuition and Geometry
Nature and History of Pi
Computation of Pi
Mathematics and Music
The Golden Measure

## SPANISH TRANSLATIONS

Some of the texts listed above have been translated into Spanish for use in Puerto Rico. Translations of the teacher's commentaries are also available. In some cases, the teacher's commentaries but not the student texts for grades 4, 5, and 6 have also been translated as have been three volumes for teachers from the studies in mathematics series.

Matematicas Para El Primer Ciclo Secundario,
  Volumen I
Matematicas Para El Primer Ciclo Secundario,
  Volumen II
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Introducción A Sistemas Numéricos

## STUDIES IN MATHEMATICS

The books in this series are all intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

Euclidean Geometry Based on
Ruler and Protractor Axioms
Structure of Elementary Algebra
Geometry
Concepts of Informal Geometry
Number Systems
Intuitive Geometry
Concepts of Algebra
Brief Course in Math for
Elementary School Teachers
Applied Mathematics in the High School
Mathematical Methods in Science
Brief Course for Junior High School
Teachers
Inservice Course for Primary School Teachers
Introduction to Number Systems
Calculus and Science
Some Uses of Mathematics

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were held to acquaint teachers with the contents and objectives of SMSG texts. Others were devoted to discussions of problems in mathematics education and the role of SMSG in attacking these problems.

Elementary School Mathematics
Orientation Conference for
SMSG Experimental Centers
Orientation Conference for SMSG Elementary
School Experimental Centers
Orientation Conference for
Geometry with Coordinates
Future Responsibilities for School
Mathematics
Mathematics Education for
Below Average Achievers

## STUDY GUIDES IN MATHEMATICS

These consist of annotated bibliographies on various parts of mathematics, all bound in one pamphlet. They are intended for teachers wishing to study by themselves and also for those planning courses for teachers.

Study Guides in Mathematics
(Algebra, Calculus, Geometry, Number Theory, Probability and Statistics, Digital Computing and Related Mathematics, Intermediate Mathematics)

## NEW MATHEMATICAL LIBRARY

This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

The authors of these monographs are mathematicians interested and well versed in the fields they treat.

A trade edition of these monographs is available through Random House. In addition, a special edition is available only to high school students and teachers at a reduced rate from the L. W. Singer Co. An order form appears on page 25.

Niven – Numbers: Rational and Irrational (NML-1)
Sawyer – What is Calculus About? (NML-2)
Beckenbach and Bellman – An Introduction to Inequalities (NML-3)
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## MISCELLANEOUS PUBLICATIONS

Very Short Course in Mathematics for Parents

This booklet is designed to give parents (and other interested persons) a chance to work through a small sample of "modern" mathematics and thus to see more clearly how and in what ways the "modern" treatment differs from the traditional.

Philosophies and Procedures of SMSG Writing Teams

Brief accounts of the philosophies developed by SMSG writing teams and the procedures used in preparing the SMSG texts.

SMSG: The Making of a Curriculum, by William Wooton

This book records the activities of the school mathematics study group from 1958 to 1962.

## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

This course consists of thirty half-hour color films. The series is intended primarily for inservice elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementary school mathematics programs. The series is mathematical in content but no mathematical prerequisites are presumed. Studies in Mathematics, Vol. 9, is designed to accompany this filmed course.

The first sixteen of these films provide a suitable background in mathematics for teachers of grades K-3. The remainder, building on these, are concerned with mathematics normally taught in grades 4-6.

The distributor for these films is Modern Learning Aids, 3 East 54th Street, New York, New York 10022. Distribution will be from the following five locations: 160 E. Grand Avenue, Chicago, Illinois 60611; 1411 Slocum Street, Dallas, Texas 75207; 714 Spring Street, N.W., Atlanta, Georgia 30308;

444 Market Street, San Francisco, California 94105; and 315 Springfield Avenue, Summit, New Jersey 07901.

## NEWSLETTERS

In order to keep the mathematical community informed, an SMSG Newsletter is published from time to time. A postcard request is sufficient for one to be placed on the mailing list.

The following issues are still available in limited quantities from: SMSG – Cedar Hall, Stanford University, Stanford, California 94305.

Newsletter No. 10 – Reports on Student Achievement in SMSG Courses

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Newsletter No. 17 – Panel on Supplementary Publications

Newsletter No. 19 – Report of a Survey of Inservice Programs for Mathematics Teachers

Newsletter No. 21 – The New Mathematical Library

Newsletter No. 23 – Panel on Supplementary Publications

Newsletter No. 24 – General Information

Newsletter No. 25 – Articulation of Content of SMSG Texts Grades 7-10

## REPORTS

This series consists of reports, too long to be included in SMSG Newsletters, on various SMSG projects. Single copies may be obtained by a postcard request to SMSG, Cedar Hall, Stanford University, Stanford, California 94305.

1. The SMSG Programed Learning Project
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# SCHOOL
# MATHEMATICS
# STUDY GROUP

## Newsletter No. 27

*November 1967*

## RECENT PUBLICATIONS

In this Newsletter we call to the attention of the mathematical community some new SMSG publications, as well as a few others which, although announced in an earlier Newsletter, were not described there at any length.

## CONTENTS

Developing Mathematics Readiness for Pre-School Programs, 3

Mathematics for Culturally Disadvantaged Children, 3

Probability Units, 4

Algorithms, Computation and Mathematics, 6

Reprint Series, 7

Studies in Mathematics, 8

Order Form, 14

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*DEVELOPING MATHEMATICS READINESS FOR PRE-SCHOOL PROGRAMS* by William G. Chinn and Jeanette Summerfield

This booklet describes a number of activities which are appropriate for pre-school programs and which are designed to prepare young children for the kind of kindergarten and first grade mathematics program which SMSG has suggested.

These activities were developed jointly by a small task force at SMSG headquarters and the teachers in a pre-school program for culturally disadvantaged children at the San Ramon Elementary School in Mt. View, California. Before these activities were developed, the teacher had been made thoroughly acquainted with the mathematical concepts included in the SMSG kindergarten and first grade program. After they were developed, they were then tried out by the teachers and revised, modified, and extended on the basis of these tryouts. After an activity was deemed to be satisfactory, a description of it was prepared by the SMSG staff and reviewed by the teachers.

Each unit consists of a section on background notes, readiness, activities, and vocabulary. The writers made a special effort to make sure that the mathematical concepts aimed at in any particular activity were clearly presented. Thus, most topics are discussed more intensively more than they are intended to be developed for the children at this level.

## MATHEMATICS FOR CULTURALLY DISADVANTAGED CHILDREN

*MATHEMATICS FOR THE ELEMENTARY SCHOOL – SPECIAL EDITIONS*

Book K, Teacher's Commentary
Book 1, Student's Text, Parts I and II
Book 1, Teacher's Commentary, Parts I and II

During the academic year 1964–65, seven kindergarten and seven first grade classes in culturally disadvantaged areas in six large cities used SMSG text materials. Inservice assistance was provided to the teachers, and the students were tested at the beginning and at the end of the year.

The participating teachers met four times during the year to report on their progress and their special problems.

The information thus gained from this observation program was made use of in the preparation of special editions of the teacher's commentary for kindergarten and for grade one. These are designed to help make the SMSG program more accessible to culturally disadvantaged students.

A book for teachers of culturally disadvantaged primary school children has also been prepared. See page 8.

## PROBABILITY UNITS

### *PROBABILITY FOR PRIMARY GRADES*

*Why Do We Teach Probability?*

The study of probability has come to be an important part of the mathematics curriculum on higher levels. Probability has many practical uses. It is used in making decision in the fields of military operations, scientific research, designing and manufacturing machines, insurance calculations, business predictions, weather forecasting, and in many other areas.

Probability is, of course, also used in games of chance. In fact, early research in the study of probability developed from a mathematician's interest in a friend's unsuccessful and imprudent wager.

"Goals for School Mathematics," the report of the 1963 Cambridge Conference, recommended that some of the basic ideas of probability should be introduced very early in the school program, and the School Mathematics Study Group undertook the development of materials for grades kindergarten to high school.

*What Are We Trying To Do In This Unit?*

Even quite young children are not strangers to probability on a practical level. They hear the words "not very likely," and they play games using spinners or dice, or games which involve drawing a card from a shuffled deck. By the very fact of playing the game, children demonstrate their idea that they have a chance of winning equal to that of the opponent.

It is on this level, and with these primitive ideas of "equal chance," "better chance," "not as likely as," "sure thing," etc., that the unit on probability for primary grades is written. To use and improve children's intuitive knowledge of what constitutes "an equal chance" or "a better chance," and to show – though not in so many words – that there is mathematical justification for many of their ideas will, it is hoped, make further study of probability easier, more desirable, and more fruitful.

*(from the author's preface)*

### *PROBABILITY FOR INTERMEDIATE GRADES*

Children's natural interest in games provides a high level of motivation for the study of probability. This unit capitalizes on that interest and motivation by using experimental activities to introduce some of the basic ideas of probability. As children classify and tabulate data gathered from these experimental activities, they are guided to discover patterns which enable them to formulate hypotheses and reach tentative conclusions about situations which involve chance events. Ultimately they are led to discover that there are mathematical justifications for many of their intuitive ideas and that mathematics can be used to test the validity of their intuitive ideas.

One of the goals of instruction is to promote systematic thinking rather than a hit-or-miss approach which encourages jumping to conclusions. Efforts are made throughout the unit to demonstrate the advantages of a logical and systematic approach.

There are unlimited opportunities for the practice and reinforcement of arithmetic skills ranging from simple addition facts to the multiplication of common fractions. The construction and interpretation of graphs should contribute to increased pupil understanding in areas such as economics, geography, and history, as well as mathematics.

There are opportunities for independent investigation – one might almost say research – by individual children. The teacher, too, may seize opportunities to carry the work further when individual or group interests indicate that this is desirable. Also, the Appendix in the pupil book which describes probability devices may be of help in such situations.

*(from the author's preface)*

### *INTRODUCTION TO PROBABILITY – BASIC CONCEPTS – PART 1*

The material in Part 1 is written for students at approximately the seventh or eighth grade level. It is presumed that the student has an adequate background in arithmetic. Working with problems in probability will provide excellent practice in handling fractions and decimals. No previous experience with probability is assumed. Those students who have had an opportunity to study SMSG: PROBABILITY FOR INTERMEDIATE GRADES will, obviously, have a headstart on the ideas of this volume. For such students, Chapters 1 to 6 may be covered very rapidly.

Some familiarity with the language and notation of sets is pre-supposed. Students with no previous experience with this language and notation may need a brief introduction.

Parts of the volume are in "programmed" form. This allows the text to be used for individual study or to be used at different rates by different class members. It is also possible to use the book as a regular text, supplementing the material by class discussion and using the exercises as out-of-class work.

Chapter 1. Introduction
Chapter 2. Finding Probabilities
Chapter 3. Counting Outcomes
Chapter 4. Estimating Probabilities
Chapter 5. The Probability of A or B
Chapter 6. P (A $\cap$ B), The Probability of A and B
Chapter 7. Conditional Probability
Appendix. Odds

## *INTRODUCTION TO PROBABILITY – SPECIAL TOPICS – PART 2*

It is assumed, throughout this volume, that the reader has completed Chapters 1 to 6 of SMSG Introduction to Probability – Part 1. In addition, certain topics depend heavily on the ideas about conditional probability developed in Chapter 7 of Part 1. Others require some familiarity with certain ideas and skills of elementary algebra.

Chapter 8. Bayes' Formula
Chapter 9. Bernoulli Trials
Chapter 10. Mathematical Expectation
Chapter 11. Bertrand's Ballot Problem
Chapter 12. Markov Chains
Appendix. The Law of Large Numbers

## *ALGORITHMS, COMPUTATION AND MATHEMATICS*

Many of the concepts which are fundamental to computer science are mathematical as well as elementary. They are suitable for presentation at the high school or early college level. For these and other reasons we find various computer concepts being taught today to a rapidly growing number of our high school students.

During the past several years there has been a maturing conviction (certainly among those in a position to advise SMSG) that the computer topics which are introduced especially to the college capable student should be

(1) carefully related to the "new mathematics" which the student has already been learning, thereby emphasizing its value, and fortifying its general impact on the student;

(2) extended to those areas of mathematics which can best describe or explain the functional behavior of discrete (digital) information systems and the processes conducted by them.

Following these guidelines, SMSG has prepared a text on computing, for use in a 12th grade course in mathematics, entitled "Algorithms, Computation and Mathematics." The text deals chiefly, as the title would indicate, with the nature of digital computers, algorithmic concepts of numerical and non-numerical problem solving, and related mathematics. The text itself does not require a specific programming language and two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL.

Chapter 1. Algorithms, Language and Machines
Chapter 2. Input, Output and Assignment
Chapter 3. Branching and Subscripted Variables
Chapter 4. Looping
Chapter 5. Functions and Procedures
Chapter 6. Approximations
Chapter 7. Some Mathematical Applications
Chapter 8. Compilation and Some Other Non-Numeric Problems
Epilogue The Future for Computers

(A supplement for the MAD language has been prepared by E. I. Organick and can be obtained from Ulrich's Bookstore, 549 E. University Avenue, Ann Arbor, Michigan.)

## REPRINT SERIES

Mathematics is such a vast and rapidly expanding field of study that there are inevitably many important and fascinating aspects of the subject which do not find a place in the curriculum simply because of lack of time, even though they are well within the grasp of secondary school students.

Some classes and many individual students, however, may find time to pursue mathematical topics of special interest to them. The School Mathematics Study Group is preparing pamphlets designed to make material for such study readily accessible. Some of the pamphlets deal with material found in the regular curriculum but in a more extended manner or from a novel point of view. Others deal with topics not usually found at all in the standard curriculum.

This particular series of pamphlets, the Reprint Series, makes available expository articles which appeared in a variety of mathematical periodicals. Even if the periodicals' were available to all schools, there is convenience in having articles on one topic collected and reprinted as is done here. The following are now available:

| | |
|---|---|
| RS-1 | The Structure of Algebra |
| RS-2 | Prime Numbers and Perfect Numbers |
| RS-3 | What is Contemporary Mathematics? |
| RS-4 | Mascheroni Constructions |
| RS-5 | Space, Intuition and Geometry |
| RS-6 | Nature and History of $\pi$ |
| RS-7 | Computation of $\pi$ |
| RS-8 | Mathematics and Music |
| RS-9 | The Golden Measure |
| RS-10 | Geometric Constructions |

## STUDIES IN MATHEMATICS

The series "Studies in Mathematics" is designed primarily for classroom teachers. The five volumes described in the following have been recently published.

### *STUDIES IN MATHEMATICS, VOLUME XIII, INSERVICE COURSE IN MATHEMATICS FOR PRIMARY SCHOOL TEACHERS*

In general, schools today are becoming increasingly aware of the need to orient the teaching of mathematics in accord with a conceptual development of Mathematical ideas. Yet, too frequently an assumption is made that for a population of children that is considered to be "culturally disadvantaged," rote learning is still the only answer to learning mathematics. This course of action would further deprive these children. A feature of this text is an attempt to attend to problems that may be associated with the culturally disadvantaged.

The introductory chapter begins with a description of the culturally disadvantaged based on psychological findings. It continues with the physical, social, and psychological environment in which these children function in their preschool years. The next concern is with the characteristics manifest in the culturally disadvantaged children as they enter school. Finally, implications for teaching these children are discussed in this chapter.

Chapters 1 through 17 present mathematical content relevant to teaching in the primary grades. All topics which are included in the texts for the School Mathematics Study Group Books K and i are treated, but from a more sophisticated point of view. Other topics have been included when the development has warranted it.

### *STUDIES IN MATHEMATICS, VOLUME XIV, INTRODUCTION TO NUMBER SYSTEMS*

The aim of this book is to help the teacher acquire background for the material which is presented to the junior high school student in the books of the School Mathematics Study Group and other books with similar coverage. It is obvious that any teacher of any subject must know more than he teaches so that he will not be the slave of the textbook nor live in fear of his bright students. Hence we here deal with the development of the system of rational numbers beginning with the properties of the integers as we know them, why they are important, why we make certain definitions in extending the set of integers to the rational numbers and what are their consequences. Hand-in-hand go the graphical representation of numbers and pairs of numbers, for the interplay of geometry and number is important to both branches. Since the idea of equation is also fundamental to the understanding of various connections, we include something of this subject. The real number system, because of its complexity, is dealt with only very intuitively, and complex numbers are relegated to an appendix. Most of all is the attempt made to develop a mathematical structure of numbers based on reasonable axioms and developed along paths pointed out by intuition and made secure by proof.

*(from the author's preface)*

### *STUDIES IN MATHEMATICS, VOLUME XV, CALCULUS AND SCIENCE*

Problems from the sciences that are injected into mathematics texts (to serve as vehicles for the development of theory or as examples for the use of theory) often exhibit the mathematical sciences as short-order menus and applied mathematics as the corresponding cook-books. We sought to counter this in the SMSG 12th grade text *Calculus.* In addition to exploiting applications to motivate the development of the subject and to illustrate some of its special consequences it was decided that it would be of interest to attempt a systematic development of applications. As part of this program, I prepared one chapter (9: Growth, Decay and Competition) to show how essentially one general method of the calculus is used in many different sciences, and another (15: Geometrical Optics and Waves) to show how different methods of the calculus have furthered the development of essentially one field of science.

In the present volume, I have modified these two chapters to make them independent of the original text, so that they may serve as a math-science supplement to other programs. As such, the present material forms part of the series started by Volumes X and XI of the SMSG Studies in Mathematics, volumes based on the lectures for high school mathematics teachers given by Max M. Schiffer (*Applied Mathematics in the High School*, Volume X) and by George Polya (*Mathematical Methods in Science*, Volume XI). In an attempt to provide similar motivation for the audience addressed by Schiffer and by Polya, this volume begins with an introduction suggesting the inclusion of math-science material at the secondary level; much of this appeared in the *Calculus* (1–3: The Scope of Calculus, or in the Teacher's Commentary), and in both books it helps prepare the reader for subsequent material.

*(from the author's preface)*

### *STUDIES IN MATHEMATICS, VOLUME XVI, SOME USES OF MATHEMATICS: A SOURCE BOOK FOR TEACHERS AND STUDENTS OF SCHOOL MATHEMATICS*

For many years there has been widespread agreement on the proposition that school mathematics instruction should include attention to genuine, non-trivial, uses of mathematics. The demand for this has increased in recent years with the discovery of the usefulness of mathematical methods and models in many fields that have heretofore pretty much done without mathematics (e.g., business, the social sciences). But the problem of making applications a viable part of school instruction has remained pretty much unsolved, as an examination of school books of any time period will confirm. There is hope for a change in this state of affairs, however, in the fact that the more widespread use of mathematics in new fields has also fostered an array of excellent expositions in the scholarly and semi-popular literature that could be adapted to school use in talking about applications. The trouble is that many of the best of these expositions are virtually unavailable to those who could make the best use of them for school purposes.

Studies in Mathematics, Volume XVI, contains a collection of articles that is intended precisely to demonstrate the *existence* of materials on mathematical models and applications that are adaptable to school use and also to help solve the problem of *availability*. The collection is a subset of a larger group of articles, each selected according to the following criteria:

1. Each article should deal in a general way or by specific example with applications of mathematics or with mathematical models in a nontrivial and informative way.
2. Each article should be a good exposition written in plain English.
3. Each article should require for its understanding *at most* the mathematics that would normally be available in a good secondary school curriculum, though more advanced mathematics might be referred to.

Several of the articles in the collection deal in a general or philosophical way with the process of building and using so-called mathematical models. Several deal with possible consequences of the impact of computers and of the more widespread exploitation of mathematical methods for practical purposes. Some explain briefly a variety of uses of mathematics in given fields. A number work through specific examples in some detail. It is possible to imagine the collection being used for individual study by teachers, for teacher training purposes, as a supplementary book for students (perhaps worked into the regular curriculum over a period of several years), or as a source of examples to be adapted by textbook writers or by individual teachers for use in regular instruction. Although the expositions are mainly geared to an adult level of reading and reasoning, very few would require technical mathematics beyond the Algebra I level.

*(from the editor's preface)*

### *STUDIES IN MATHEMATICS, VOLUME XVII, MATHEMATICAL CONCEPTS OF ELEMENTARY MEASUREMENT*

This book began as an attempt to "explain what measurement is about, from the point of view of a mathematician." It was intended that there would be a companion book, written from a scientific viewpoint. It soon became apparent that a book about measurement, written from either point of view, would have to say something about the other. It also became apparent that the original objective was inappropriate: the question of "what measurement is about" is not mathematical, but philosophical. Much has been written (and much more will undoubtedly be written) by scientists and philosophers, on the subject of measurement. Most of these writers find it necessary to use mathematical ideas in their "explanations"; but, from a mathematical point of view, their treatment of the relevant mathematical ideas, and of the connections between these ideas, frequently leaves much to be desired. It is an objective of the present book to help to fill this gap: to identify those mathematical concepts which are relevant to elementary measurement, and to exhibit their logical inter-relationships.

In comparatively recent times, it has been discovered that mathematics has no necessary logical connection with the real world. This discovery has been accompanied by an ever growing expansion of the activity, often called "model-building," which seeks to link the empirical structures of the sciences with the formal structures of mathematics. This link is established by means of functions, which map (or "model") empirical systems into mathematical systems, in such a way that structures arrived at empirically and inductively are carried over into corresponding mathematical structures. Sometimes this process makes use of existing mathematical systems, and sometimes new mathematical systems are created to provide appropriate model spaces. Among the mathematical systems in most frequent use as model spaces are the various number systems (the whole numbers, the rational numbers, the real numbers, the complex numbers), various geometric spaces, vector spaces, and so on. Many model functions are, in fact, complex and inter-related collections of simpler functions, and it is these simple functions (which are associated directly with the processes of measurement) and their relationships with one another, which are one of our main concerns in this book.

The book has been written with high school mathematics teachers in mind, but it is hoped that some of it will be within the grasp of elementary school teachers, and that it might be usefully read by teachers of science, and by college teachers. The principal concern of the book is to exploit the idea that "measurement involves structure-preserving functions" in order to provide a conceptual framework in whch the elementary ideas of measurement can be understood.

*(from the author's preface)*

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# Newsletter No. 29

*March 1968*

SMSG PUBLICATIONS

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# BRIEF DESCRIPTIONS OF SMSG PUBLICATIONS

## HIGH SCHOOL TEXTBOOKS

These texts are designed for average and above average students in a college preparatory program.

The first four texts listed below were produced simultaneously and hence no one of them presupposes that students using them had studied anything other than a conventional curriculum previously. Newsletter 25 (see page 11) will be of interest to teachers planning to use any of these texts.

The remaining texts on the list below were prepared after the first five and, in general, do take account of the earlier SMSG texts.

The *Programed Algebra* text has a separate response booklet so the text is reusable. *Geometry With Coordinates* is designed as an alternative to *Geometry*, putting more emphasis on analytic geometry. *Matrix Algebra* and *Analytic Geometry* are intended for students who have completed the prerequisites for calculus but wish to postpone study of this subject until college.

*Algorithms, Computation, and Mathematics* is a one semester course intended for the last year of high school. It is concerned with mathematical concepts which are fundamental to computer science. The text itself does not require a specific programing language and two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL.

*Calculus* appears in three parts. The first two together constitute a normal one year course and cover, for example, the CEEB advanced placement syllabus. Part three, which is available separately, takes up supplementary topics, mainly applications of calculus to the physical sciences.

Each text is accompanied by an extensive teacher's commentary.

*First Course in Algebra*
*Geometry*
*Intermediate Mathematics*
*Elementary Functions*
*Introduction to Matrix Algebra*
*Programed First Course in Algebra*
*Geometry with Coordinates*
*Analytic Geometry*
*Algorithms, Computation, and Mathematics*
*Calculus*

## JUNIOR HIGH SCHOOL TEXTS

These texts renew and extend the mathematics of the elementary school in such a way as to provide a sound intuitive foundation for high school courses. A considerable amount of informal geometry is included.

These texts were prepared for students who had only a conventional mathematics program in elementary school. Teachers using these texts with students who have had a more modern elementary program will be interested in Newsletter No. 25 (see page 11).

*Mathematics for Junior High School, Volume I*
*Mathematics for Junior High School, Volume II*

## TEXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in the texts for grades 7–9 listed above. However, the level of reading difficulty has been reduced to make them more suitable for students who are slightly below average in ability. It is expected that such students will proceed through these materials at a reduced rate.

Report No. 5 (see page 11) deals with a study of the use of these texts with students in the 25th to 50th percentile in aptitude.

Each text is accompanied by an extensive teacher's commentary.

*Introduction to Secondary School Mathematics, Volume I*
*Introduction to Secondary School Mathematics, Volume II*
*Introduction to Algebra*

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4–6 presuppose a conventional program through grade 3. Teachers using these texts with students who have had a more modern primary school program will be interested in Newsletter No. 28 (see page 11). The emphasis in all these texts is similar to that of the Junior High School texts.

In the Teacher's Commentary for each text all pages of the student text are reproduced. For Kindergarten there is only a teacher's book.

*Mathematics for the Elementary School, Book K (Teacher's Commentary only)*
*Mathematics for the Elementary School, Book 1*
*Mathematics for the Elementary School, Book 2*

*Mathematics for the Elementary School, Book 3*
*Mathematics for the Elementary School, Grade 4*
*Mathematics for the Elementary School, Grade 5*
*Mathematics for the Elementary School, Grade 6*

## MATHEMATICS FOR CULTURALLY DISADVANTAGED CHILDREN

Special editions of the teacher's commentary for kindergarten and for grade one as well as the student work book for grade one have been prepared for use with culturally disadvantaged children. Studies in Mathematics, Volume 13 (listed below), is designed for use in in-service courses for teachers planning to use these materials.

Reports No. 2 and 4 (see page 11) will be of interest to those contemplating use of these materials.

The last item on the list below is a booklet which describes a number of activities appropriate for pre-school programs and designed to prepare young children for the kind of kindergarten and first grade mathematics program which SMSG has suggested.

*Mathematics for the Elementary School, Book K, Special Edition*
*Mathematics for the Elementary School, Book 1, Special Edition*
*Developing Mathematics Readiness in Pre-School Programs*

## SUPPLEMENTARY MATERIALS

A variety of booklets is available. Their common characteristic is that each requires less than a full academic year.

The first three of the following booklets use simple experiments from physical science to introduce and motivate mathematical ideas. They are designed for grades seven, eight, and nine. The later booklets do not presuppose study of the earlier ones.

The fourth booklet below parallels *Mathematics Through Science, Part 2*, but uses simple experiments from biological science rather than physical science.

*Mathematics Through Science, Part 1*
*Mathematics Through Science, Part 2*
*Mathematics Through Science, Part 3*
*Mathematics and Living Things*

The next booklet contains material not included in the textbooks for grades seven and eight and is designed for abler students.

*Junior High School Supplementary Unit*

The next two booklets are designed for outside reading by students in grades nine through twelve.

*Essays on Number Theory I*
*Essays on Number Theory II*

The following booklet, based on the first chapter of "Intermediate Mathematics," provides a review of the structural properties of the real number system and of its subsystems.

*Development of the Real Number System*

## PROBABILITY UNITS

Two pamphlets on probability have been prepared, one for the primary grades and one for the intermediate elementary school grades. A classroom set of spinners is available for use with each of these.

A programed short text on probability for use in junior high school is also available and a second programed text, presupposing the first and probably more suitable for senior high school, is also available.

*Probability for Primary Grades*
*Probability for Intermediate Grades*
*Introduction to Probability, Part I*
*Basic Concepts*
*Introduction to Probability, Part II*
*Special Topics*

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets are designed to allow teachers to try short modern treatments of particular mathematics topics in class. Some, however, are designed for independent study or enrichment. Teacher's commentaries are available for some of these.

*Functions*
*Circular Functions*
*The Complex Number System*
*The System of Vectors*
*Non-Metric Geometry*
*Plane Coordinate Geometry*
*Inequalities*
*Numeration*
*Algebraic Structures*
*Factors and Primes*
*Mathematical Systems*
*Systems of First Degree Equations in*
*Three Variables*

*Radioactive Decay*
*Absolute Value*
*Mathematical Theory of the Struggle for Life*
*1 + 1 = ?*

## REPRINT SERIES

Each of these pamphlets is devoted to a particular topic in mathematics and contains reprints of articles selected from a variety of journals.

*The Structure of Algebra*
*Prime Numbers and Perfect Numbers*
*What is Contemporary Mathematics?*
*Mascheroni Constructions*
*Space, Intuition and Geometry*
*Nature and History of Pi*
*Computation of Pi*
*Mathematics and Music*
*The Golden Measure*
*Geometric Constructions*

## SPANISH TRANSLATIONS

Some of the texts listed above have been translated into Spanish for use in Puerto Rico. Translations of the teacher's commentaries are also available in some cases. The teacher's commentaries, but not the student texts, for grades 4, 5, and 6 have also been translated, as have been three volumes for teachers from the Studies in Mathematics series.

*Matematicas Para El Primer Ciclo*
  *Secundario, Volumen I*
*Matematicas Para El Primer Ciclo*
  *Secundario, Volumen II*
*Matematica Para La Escuela Secundaria,*
  *Primer Curso de Algebra*
*Matematica Para La Escuela Secundaria,*
  *Geometria*
*Matematica Para La Escuela Secundaria,*
  *Matematica Intermedia*
*Matematicas Para La Escuela Secundaria,*
  *Introducción Al Algebra De Las Matrices*
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  *Funciones Elementales*
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*Conceptos De Geometria Intuitive*
*El Curso Conciso En Matematica Para Los*
  *Profesores De Escuela Primaria*
*Introducción A Sistemas Numéricos*

## STUDIES IN MATHEMATICS

The books in this series are all intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

*Euclidean Geometry Based on*
*Ruler and Protractor Axioms*
*Structure of Elementary Algebra*
*Geometry*
*Concepts of Informal Geometry*
*Number Systems*
*Intuitive Geometry*
*Concepts of Algebra*
*Brief Course in Mathematics for*
*Elementary School Teachers*
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*Mathematical Methods in Science*
*Brief Course for Junior High School*
*Teachers*
*Inservice Course for Primary School Teachers*
*Introduction to Number Systems*
*Calculus and Science*
*Some Uses of Mathematics*
*Mathematical Concepts of Elementary*
*Measurement*

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were held to acquaint teachers with the contents and objectives of SMSG texts. Others were devoted to discussions of problems in mathematics education and the role of SMSG in attacking these problems.

*Elementary School Mathematics*
*Orientation Conference for SMSG*
*Experimental Centers*
*Orientation Conference for SMSG Elementary*
*School Experimental Centers*
*Orientation Conference for*
*Geometry with Coordinates*
*Future Responsibilities for School*
*Mathematics*
*Mathematics Education for*
*Below Average Achievers*
*A Conference on Mathematics*
*For Gifted Students*

## NEW MATHEMATICAL LIBRARY

This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

The authors of these monographs are mathematicians interested and well versed in the fields they treat.

A trade edition of these monographs is available through Random House. In addition, a special edition is available only to high school students and teachers at a reduced rate from the L. W. Singer Co. An order form appears on page 23.

*Niven — Numbers: Rational and Irrational (NML-1)*
*Sawyer — What is Calculus About? (NML-2)*
*Beckenbach and Bellman — An Introduction to Inequalities (NML-3)*
*Kazarinoff — Geometric Inequalities (NML-4)*
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*Ore — Invitation to Number Theory (NML-20)*
*(in preparation)*

## MISCELLANEOUS PUBLICATIONS

*Very Short Course in Mathematics for Parents*

This booklet is designed to give parents (and other interested persons) a chance to work through a small sample of "modern" mathematics and thus to see more clearly how and in what ways the "modern" treatment differs from the traditional.

*Philosophies and Procedures of SMSG Writing Teams*

Brief accounts of the philosophies developed by SMSG writing teams and the procedures used in preparing the SMSG texts.

*SMSG: The Making of a Curriculum, by William Wooton*

This book records the activities of the School Mathematics Study Group from 1958 to 1962.

## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

This course consists of thirty half-hour color films. The series is intended primarily for inservice elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementary school mathematics programs. The series is mathematical in content but no mathematical prerequisites are presumed. Studies in Mathematics, Vol. 9, is designed to accompany this filmed course.

The first sixteen of these films provide a suitable background in mathematics for teachers of grades K-3. The remainder, building on these, are concerned with mathematics normally taught in grades 4-6.

The distributor for these films is Modern Learning Aids, 3 East 54th Street, New York, New York 10022. Distribution will be from the following five locations: 160 E. Grand Avenue, Chicago, Illinois 60611; 1411 Slocum Street, Dallas, Texas 75207; 714 Spring Street, N.W., Atlanta, Georgia 30308; 444 Market Street, San Francisco, California 94105; and 315 Springfield Avenue, Summit, New Jersey 07901.

## NEWSLETTERS

In order to keep the mathematical community informed, an SMSG Newsletter is published from time to time. A postcard request is sufficient for one to be placed on the mailing list.

The following issues are still available in limited quantities from: SMSG – Cedar Hall, Stanford University, Stanford, California 94305.

Newsletter No. 10 – Reports on Student Achievement in SMSG Courses

Newsletter No. 15 – Reports

Newsletter No. 17 – Panel on Supplementary Publications

Newsletter No. 19 – Report of a Survey of Inservice Programs for Mathematics Teachers

Newsletter No. 21 – The New Mathematical Library

Newsletter No. 23 – Panel on Supplementary Publications
Newsletter No. 24 – General Information
Newsletter No. 25 – Articulation of Content of SMSG Texts Grades 7–10
Newsletter No. 28 – Articulation of Content of SMSG Texts Grades 1–3 and Grade 4

## REPORTS

This series consists of reports, too long to be included in SMSG Newsletters, on various SMSG projects. Single copies may be obtained by a postcard request to SMSG, Cedar Hall, Stanford University, Stanford, California 94305.

1. The SMSG Programed Learning Project
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6. Preliminary Report on an Experiment with Junior High School Very Low Achievers in Mathematics.

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9. As it takes longer to process an order during the rush period in July, August, and September, we urgently suggest that you place your order well in advance of your needs. Orders will be shipped on a first come, first served basis.

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| ______ | Ore — Graphs and Their Uses (NML-10) | $1.29 | ______ |
| ______ | Hungarian Problem Book I (NML-11) | $1.29 | ______ |
| ______ | Hungarian Problem Book II (NML-12) | $1.29 | ______ |
| ______ | Aaboe — Episodes from the Early History of Mathematics (NML-13) | $1.29 | ______ |
| ______ | Grossman and Magnus — Groups and their Graphs (NML-14) | $1.29 | ______ |
| ______ | Niven — Mathematics of Choice (NML-15) | $1.29 | ______ |
| ______ | Friedrichs — From Pythagoras to Einstein (NML-16) | $1.29 | ______ |
| ______ | The Contest Problem Book II (NML-17) | $1.29 | ______ |
| ______ | Chinn and Steenrod — First Concepts of Topology (NML-18) | $1.29 | ______ |
| ______ | Coxeter and Greitzer — Geometry Revisited (NML-19) | $1.29 | ______ |
| ______ | Ore — Invitation to Number Theory (NML-20) (in preparation) | $1.29 | ______ |

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12.

## INFORMATION ON ORDERING

Three separate editions of the **New Mathematical Library** are now available:

A trade edition is published by Random House, Inc. Each volume in this edition is priced at $1.95. This edition is available in book stores or may be ordered by mail from:

Random House, Inc.
457 Madison Avenue
New York, N. Y. 10022

A hard bound library edition is distributed by School and Library Services: Each volume in this edition is priced at $2.95, and can be ordered from:

School and Library Serivces
457 Madison Avenue
New York, N. Y. 10022

A reduced price edition is available from L. W. Singer Company, **but only to elementary and secondary schools.** Each volume in this paper bound edition is priced at $1.29. An order form for school use is on the reverse side of this page.

SCHOOL
MATHEMATICS
STUDY GROUP

# Newsletter No. 31

*April 1969*

## SMSG PUBLICATIONS

# BRIEF DESCRIPTIONS OF SMSG PUBLICATIONS

## HIGH SCHOOL TEXTBOOKS

These texts are designed for average and above average students in a college preparatory program.

The first four texts listed below were produced simultaneously and hence no one of them presupposes that students using them had studied anything other than a conventional curriculum previously. Newsletter 25 (see page 11) will be of interest to teachers planning to use any of these texts.

The remaining texts on the list below were prepared after the first five and, in general, do take account of the earlier SMSG texts.

The *Programed Algebra* text has a separate response booklet so the text is reusable. *Geometry With Coordinates* is designed as an alternative to *Geometry*, putting more emphasis on analytic geometry. *Matrix Algebra* and *Analytic Geometry* are intended for students who have completed the prerequisites for calculus but wish to postpone study of this subject until college.

*Algorithms, Computation, and Mathematics* is a one semester course intended for the last year of high school. It is concerned with mathematical concepts which are fundamental to computer science. The text itself does not require a specific programing language and two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL.

*Calculus* appears in three parts. The first two together constitute a normal one year course and cover, for example, the CEEB Calculus BC advanced placement syllabus. Part three, which is available separately, takes up supplementary topics, mainly applications of calculus to the physical sciences.

*Calculus of Elementary Functions* interweaves the content of *Elementary Functions* with an introduction to differential and integral calculus. It is designed to cover the Calculus AB syllabus of the College Board advanced placement examination.

A preliminary edition is now available for inspection. A revised version will be prepared and will be available for shipment at the end of August.

Each text is accompanied by an extensive teacher's commentary

*First Course in Algebra*

*Geometry*
*Intermedite Mathematics*
*Elementary Functions*
*Introduction to Matrix Algebra*
*Programed First Course in Algebra*
*Geometry with Coordinates*
*Analytic Geometry*
*Algorithms, Computation, and Mathematics*
*Calculus*
*Calculus of Elementary Functions*

## JUNIOR HIGH SCHOOL TEXTS

These texts renew and extend the mathematics of the elementary school in such a way as to provide a sound intuitive foundation for high school courses. A considerable amount of informal geometry is included.

These texts were prepared for students who had only a conventional mathematics program in elementary school. Teachers using these texts with students who have had a more modern elementary program will be interested in Newsletter No. 25 (see page 11).

Sample chapters of a new junior high school mathematics program are available for inspection. This new program was described in Newsletter No. 24.

*Mathematics for Junior High School, Volume I*
*Mathematics for Junior High School, Volume II*
*Sample Chapters*

## TEXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in the texts for grades 7–9 listed above. However, the level of reading difficulty has been reduced to make them more suitable for students who are slightly below average in ability. It is expected that such students will proceed through these materials at a reduced rate.

Report No. 5 (see page 11) deals with a study of the use of these texts with students in the 25th to 50th percentile in aptitude.

Each text is accompanied by an extensive teacher's commentary.

*Introduction to Secondary School Mathematics, Volume I*
*Introduction to Secondary School Mathematics, Volume II*
*Introduction to Algebra*

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4–6 presuppose a conventional program through grade 3. Teachers using these texts with students who have had a more modern primary school program will be interested in Newsletter No. 28 (see page 11). The emphasis in all these texts is similar to that of the Junior High School texts.

In the Teacher's Commentary for each text all pages of the student text are reproduced. For Kindergarten there is only a teacher's book.

*Mathematics for the Elementary School, Book K (Teacher's Commentary only)*
*Mathematics for the Elementary School, Book 1*
*Mathematics for the Elementary School, Book 2*
*Mathematics for the Elementary School, Book 3*
*Mathematics for the Elementary School, Grade 4*
*Mathematics for the Elementary School, Grade 5*
*Mathematics for the Elementary School, Grade 6*

## MATHEMATICS FOR CULTURALLY DISADVANTAGED CHILDREN

Special editions of the teacher's commentary for kindergarten and for grade one as well as the student work book for grade one have been prepared for use with culturally disadvantaged children. Studies in Mathematics, Volume 13 (listed below), is designed for use in in-service courses for teachers planning to use these materials.

Reports No. 2 and 4 (see page 11) will be of interest to those contemplating use of these materials.

The last item on the list below is a booklet which describes a number of activities appropriate for pre-school programs and designed to prepare young children for the kind of kindergarten and first grade mathematics program which SMSG has suggested.

*Mathematics for the Elementary School, Book K, Special Edition*
*Mathematics for the Elementary School, Book 1, Special Edition*
*Developing Mathematics Readiness in Pre-School Programs*

## SUPPLEMENTARY MATERIALS

A variety of booklets is available. Their common characteristic is that each requires less than a full academic year.

The first three of the following booklets use simple experiments from physical science to introduce and motivate mathematical ideas. They are designed for grades seven, eight, and nine. The later booklets do not presuppose study of the earlier ones.

The fourth booklet below parallels *Mathematics Through Science, Part 2,* but uses simple experiments from biological science rather than physical science.

*Mathematics Through Science, Part 1*
*Mathematics Through Science, Part 2*
*Mathematics Through Science, Part 3*
*Mathematics and Living Things*

The next booklet contains material not included in the textbooks for grades seven and eight and is designed for abler students.

*Junior High School Supplementary Unit*

The next two booklets are designed for outside reading by students in grades nine through twelve.

*Essays on Number Theory I*
*Essays on Number Theory II*

The following booklet, based on the first chapter of "Intermediate Mathematics," provides a review of the structural properties of the real number system and of its subsystems.

*Development of the Real Number System*

## PROBABILITY UNITS

Two pamphlets on probability have been prepared, one for the primary grades and one for the intermediate elementary school grades. A classroom set of spinners is available for use with each of these.

A programed short text on probability for use in junior high school is also available and a second programed text, presupposing the first and probably more suitable for senior high school, is also available.

*Probability for Primary Grades*
*Probability for Intermediate Grades*
*Introduction to Probability, Part I*
  *Basic Concepts*
*Introduction to Probability, Part II*
  *Special Topics*

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets are designed to allow teachers to try short modern treatments of particular mathematics topics in class. Some, however, are designed for independent study or enrichment. Teacher's commentaries are available for some of these.

*Functions*
*Circular Functions*
*The Complex Number System*
*The System of Vectors*
*Non-Metric Geometry*
*Plane Coordinate Geometry*
*Inequalities*
*Numeration*
*Algebraic Structures*
*Factors and Primes*
*Mathematical Systems*
*Systems of First Degree Equations in Three Variables*
*Radioactive Decay*
*Absolute Value*
*Mathematical Theory of the Struggle for Life*
*1 + 1 = ?*
*Order and The Real Numbers: A Guided Tour*
*The Mathematics of Trees and Other Graphs*

## REPRINT SERIES

Each of these pamphlets is devoted to a particular topic in mathematics and contains reprints of articles selected from a variety of journals.

*The Structure of Algebra*
*Prime Numbers and Perfect Numbers*
*What is Contemporary Mathematics?*
*Mascheroni Constructions*
*Space, Intuition and Geometry*
*Nature and History of Pi*
*Computation of Pi*
*Mathematics and Music*
*The Golden Measure*
*Geometric Constructions*
*Memorable Personalities in Mathematics: Nineteenth Century*
*Memorable Personalities in Mathematics: Twentieth Century*
*Finite Geometry*
*Infinity*
*Geometry, Measurement and Experience*

## SPANISH TRANSLATIONS

Some of the texts listed below have been translated into Spanish for use in Puerto Rico. Translations of the teacher's commentaries are also available in some cases. The teacher's commentaries, but not the student texts, for grades 4, 5, and 6 have also been translated, as have been three volumes for teachers from the Studies in Mathematics series.

*Matematicas Para El Primer Ciclo Secundario, Volumen I*
*Matematicas Para El Primer Ciclo Secundario, Volumen II*
*Matematica Para La Escuela Secundaria, Primer Curso de Algebra*
*Matematica Para La Escuela Secundaria, Geometria*
*Matematica Para La Escuela Secundaria, Matematica Intermedia*
*Matematicas Para La Escuela Secundaria, Introducción Al Algebra De Las Matrices*
*Matematicas Para La Escuela Secundaria, Funciones Elementales*
*Geometria Analitica*
*Matematicas Para La Escuela Primaria, Grado 4, Comentario*
*Matematicas Para La Escuela Primaria, Grado 5, Comentario*
*Matematicas Para La Escuela Primaria, Grado 6, Comentario*
*Conceptos De Geometria Intuitiva*
*El Curso Conciso En Matematica Para Los Profesores De Escuela Primaria*
*Introducción A Sistemas Numéricos*

## STUDIES IN MATHEMATICS

The books in this series are all intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

*Euclidean Geometry Based on Ruler and Protractor Axioms*
*Structure of Elementary Algebra*
*Geometry*
*Concepts of Informal Geometry*
*Number Systems*
*Intuitive Geometry*
*Concepts of Algebra*
*Brief Course in Mathematics for Elementary School Teachers*
*Applied Mathematics in the High School*
*Mathematical Methods in Science*

*Brief Course for Junior High School Teachers*
*Inservice Course for Primary School Teachers*
*Introduction to Number Systems*
*Calculus and Science*
*Some Uses of Mathematics*
*Mathematical Concepts of Elementary Measurement*
*Puzzle Problems and Games Project*

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were held to acquaint teachers with the contents and objectives of SMSG texts. Others were devoted to discussions of problems in mathematics education and the role of SMSG in attacking these problems.

*Elementary School Mathematics*
*Orientation Conference for SMSG Experimental Centers*
*Orientation Conference for SMSG Elementary School Experimental Centers*
*Orientation Conference for Geometry with Coordinates*
*Future Responsibilities for School Mathematics*
*Mathematics Education for Below Average Achievers*
*A Conference on Mathematics For Gifted Students*

## NEW MATHEMATICAL LIBRARY

This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

The authors of these monographs are mathematicians interested and well versed in the fields they treat.

A trade edition of these monographs is available through Random House. In addition, a special edition is available only to high school students and teachers at a reduced rate from the L. W. Singer Co. An order form appears on page 28.

*Niven – Numbers: Rational and Irrational (NML-1)*
*Sawyer – What is Calculus About? (NML-2)*

*Beckenbach and Bellman — An Introduction to Inequalities (NML-3)*
*Kazarinoff — Geometric Inequalities (NML-4)*
*The Contest Problem Book (NML-5)*
*Davis — The Lore of Large Numbers (NML-6)*
*Zippin — Uses of Infinity (NML-7)*
*Yaglom-Shields — Geometric Transformations (NML-8)*
*Olds — Continued Fractions (NML-9)*
*Ore — Graphs and Their Uses (NML-10)*
*Hungarian Problem Book I (NML-11)*
*Hungarian Problem Book II (NML-12)*
*Aaboe — Episodes from the Early History of Mathematics (NML-13)*
*Grossman and Magnus — Groups and their Graphs (NML-14)*
*Niven — Mathematics of Choice (NML-15)*
*Friedrichs — From Pythagoras to Einstein (NML-16)*
*Contest Problem Book II (NML-17)*
*Chinn and Steenrod — First Concepts of Topology (NML-18)*
*Coxeter and Greitzer — Geometry Revisited (NML-19)*
*Ore — Invitation to Number Theory (NML-20)*

## NLSMA REPORTS

The first six reports reproduce the test batteries used in a five year longitudinal study of mathematics achievement and provide statistical information on the various scales contained in these batteries. Report 9 contains information about the schools, communities, and teachers involved in the study.

*NLSMA Report No. 1 (Parts A and B): X-Population Test Batteries*
*NLSMA Report No. 2 (Parts A and B): Y-Population Test Batteries*
*NLSMA Report No. 3: Z-Population Test Batteries*
*NLSMA Report No. 4: Description and Statistical Properties of X-Population Scales*
*NLSMA Report No. 5: Description and Statistical Properties of Y-Population Scales*
*NLSMA Report No. 6: Description and Statistical Properties of Z-Population Scales*
*NLSMA Report No. 9: Non-Test Data*

## SOVIET STUDIES IN THE PSYCHOLOGY OF LEARNING AND TEACHING MATHEMATICS

Each volume in the series contains one or more articles under a general heading, such as the learning of mathematical concepts, the structure of mathematical abilities, or methods of teaching mathematics. The articles form neither a random nor even a representative sample of the entire Soviet literature. Instead, the editors have chosen, from publications available to the Survey of Recent East European Mathematical Literature at the University of Chicago, articles that illustrate some of the most interesting aspects of recent Soviet pedagogical theory and research.

*Volume I. The Learning of Mathematical Concepts*
*Volume II: The Structure of Mathematical Abilities*

## INVESTIGATIONS IN MATHEMATICS EDUCATION

This journal will contain abstracts of published research reports dealing with mathematics education. Each abstract includes an objective indication of the (1) purpose, (2) rationale, (3) research design and procedure, (4) findings, and (5) the investigator's interpretation of the findings – insofar as the information has been included in the research report.

In addition, each abstractor is given an opportunity to comment upon or raise questions about the research report for which he prepares an abstract.

The first issue of this journal contains abstracts of 16 research reports published during the first half of 1968. No fixed schedule has yet been set for later issues, but it is hoped that two issues can be prepared each year.

No subscriptions to this journal can be accepted. However, a mailing list will be maintained at SMSG Headquarters and each person on the list will be notified by postcard whenever a new volume of this journal is published. Requests for inclusion on this mailing list should be addressed to:

SMSG, Cedar Hall
Stanford University
Stanford, Calif. 94305

*A Journal of Abstracts and Annotations*

## MISCELLANEOUS PUBLICATIONS

*Very Short Course in Mathematics for Parents*

This booklet is designed to give parents (and other interested persons) a chance to work through a small sample of "modern" mathematics and thus to see more clearly how and in what ways the "modern" treatment differs from the traditional.

*Philosophies and Procedures of SMSG Writing Teams*

Brief accounts of the philosophies developed by SMSG writing teams and the procedures used in preparing the SMSG texts.

*SMSG: The Making of a Curriculum, by William Wooton*

This book records the activities of the School Mathematics Study Group from 1958 to 1962.

## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

This course consists of thirty half-hour color films. The series is intended primarily for inservice elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementary school mathematics programs. The series is mathematical in content but no mathematical prerequisites are presumed. Studies in Mathematics, Vol. 9, is designed to accompany this filmed course.

The first sixteen of these films provide a suitable background in mathematics for teachers of grades K–3. The remainder, building on these, are concerned with mathematics normally taught in grades 4–6.

The distributor for these films is Modern Learning Aids, 3 East 54th Street, New York, New York 10022. Distribution will be from the following five locations: 160 E. Grand Avenue, Chicago, Illinois 60611; 1411 Slocum Street, Dallas, Texas 75207; 714 Spring Street, N.W., Atlanta, Georgia 30308; 444 Market Street, San Francisco, California 94105; and 315 Springfield Avenue, Summit, New Jersey 07901.

## NEWSLETTERS

In order to keep the mathematical community informed, an SMSG Newsletter is published from time to time. A postcard request is sufficient for one to be placed on the mailing list.

The following issues are still available in limited quantities from: SMSG – Cedar Hall, Stanford University, Stanford, California 94305.

Newsletter No. 15 – Reports
Newsletter No. 17 – Panel on Supplementary Publications
Newsletter No. 19 – Report of a Survey of Inservice Programs for Mathematics Teachers
Newsletter No. 21 – The New Mathematical Library
Newsletter No. 23 – Panel on Supplementary Publications
Newsletter No. 24 – General Information
Newsletter No. 25 – Articulation of Content of SMSG Texts Grades 7–10
Newsletter No. 28 – Articulation of Content of SMSG Texts Grades 1–3 and Grade 4
Newsletter No. 30 – Status Reports and Recent Publications

## REPORTS

This series consists of reports, too long to be included in SMSG Newsletters, on various SMSG projects. Single copies may be obtained by a postcard request to SMSG, Cedar Hall, Stanford University, Stanford, California 94305.

1. *The SMSG Programed Learning Project*
2. *The Special Curriculum Project*
3. *A Film-Film Text Study*
4. *The Special Curriculum Project: 1965–66*
5. *The Slow Learner Project: The Secondary School "Slow Learner" in Mathematics*
6. *Preliminary Report on an Experiment with Junior High School Very Low Achievers in Mathematics*
7. *Final Report on an Experiment with Junior High School Very Low Achievers in Mathematics*

## ORDER INFORMATION

1. Accredited schools will be given an educational discount of 30%. Shipping charges will be billed to the purchaser.

2. Other institutions or individuals interested in mathematics education will be given an educational discount of 30% on orders totaling $10 or more. Shipping charges will be billed to the purchaser.

3. Orders totaling less than $10, and not from accredited schools, will be billed at list price, but shipping charges by book post will be paid by A. C. Vroman.

4. Orders from individuals should be accompanied by remittance, including 5% sales tax on orders originating in California.

5. Orders from overseas accounts which have not established credit should be accompanied by remittance.

6. We regret that we are unable to supply free desk and examination copies.

7. Returns may **not** be made without prior permission.

8. We believe that it is vital to the success of the individual student as well as to the planned curriculum of the entire class, that Teacher's Commentaries not be sent by us to students. We therefore request that teachers ordering Commentaries for examination please do so on school stationery or in some other way to indicate professional status.

9. As it takes longer to process an order during the rush period in July, August, and September, we urgently suggest that you place your order well in advance of your needs. Orders will be shipped on a first come, first served basis.

10. All correspondence concerning orders should be addressed to:

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| **INTRODUCTION TO MATRIX ALGEBRA** | | | |
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| ______ | Student's Text, Parts I and II | $3.00 | ______ |
| ______ | Teacher's Commentary, Parts I and II | $3.00 | ______ |
| ______ | Student's Text, Part III | $2.00 | ______ |
| ______ | Teacher's Commentary, Part III | $2.00 | ______ |
| | **MATHEMATICS FOR JUNIOR HIGH SCHOOL** | | |
| ______ | Volume 1, Student's Text, Parts I and II | $3.00 | ______ |
| ______ | Volume 1, Teacher's Commentary, Parts I and II | $3.00 | ______ |
| ______ | Volume 2, Student's Text, Parts I and II | $3.00 | ______ |
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| ______ | Teacher's Commentary, Parts I and II | $3.00 | ______ |
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| ______ | Graphing, Equations and Linear Functions, Teacher's Commentary, Part II | $1.50 | ______ |
| ______ | An Experimental Approach to Functions, Student's Text, Part III | $1.00 | ______ |
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| | Primary Grades, Teachers Commentary | $2.00 | |
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| | Intermediate Grades, Teachers Commentary | $2.00 | |
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| | Introduction to Probability, Basic Concepts, Student's Text, Part I | $1.00 | |
| | Introduction to Probability, Special Topics, Student's Text, Part II | $1.00 | |

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| | SP-1 | Functions | $.40 | |
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A trade edition is published by Random House, Inc. Each volume in this edition is priced at $1.95. This edition is available in book stores or may be ordered by mail from:

Random House, Inc.
457 Madison Avenue
New York, N. Y. 10022

A hard bound library edition is distributed by School and Library Services. Each volume in this edition is priced at $2.95, and can be ordered from:

School and Library Services
457 Madison Avenue
New York, N. Y. 10022

A reduced price edition is available from L. W. Singer Company, **but only to elementary and secondary schools.** Each volume in this paper bound edition is priced at $1.29. An order form for school use is on the reverse side of this page.

26

7

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| | Sawyer — What Is Calculus About? (NML-2) | $1.29 | |
| | Beckenbach and Bellman — An Introduction to Inequalities (NML-3) | $1.29 | |
| | Kazarinoff — Geometric Inequalities (NML-4) | $1.29 | |
| | The Contest Problem Book (NML-5) | $1.29 | |
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# Newsletter No. 32

*March 1970*

## SMSG Publications

## NEW PUBLICATIONS

In SMSG Newsletter No. 24, October 1966, there appeared a preliminary announcement of a new SMSG curriculum project. The major outcome from this project will be a new junior high school mathematics curriculum.

Distinguishing characteristics of this new curriculum are:

(1) the usual grade placement of mathematical topics is ignored; instead, topics from arithmetic, algebra, and geometry are introduced in a logical sequence and in such a way as to provide mutual support.

(2) this curriculum is devoted solely to those mathematical concepts which the SMSG planning and writing groups believe all citizens should know in order to function effectively in our society.

(3) certain topics new to the junior high school program are included; in particular, probability, statistics, and flow charts.

(4) a strong attempt is made to make clear to the students the relevance of mathematics to problems of the real world.

Classroom tryouts of preliminary versions of many of the chapters indicate that, once teachers are familiar with the new curriculum, most college-capable students should be able to complete this curriculum in three years, i.e., by the end of grade 9. It is presumed that less able students will be able to cover the same material, but over a longer stretch of time.

A final revision of the first ten chapters will be carried out during the summer of 1970 and these chapters will be made available for general classroom use starting September, 1970, in five booklets, two chapters to each booklet.

For inspection purposes, preliminary versions of these chapters are available in two books. The first of these, entitled "Secondary School Mathematics – Sample Chapters," contains preliminary versions of the first four of these ten chapters together with teachers' commentaries. The second book, entitled "Secondary School Mathematics – Sample Chapters – Volume 2," contains the student text only for Chapters 5 through 10.

Present plans call for inspection versions of Chapters 10 through 20 to be made available in the winter of 1971, and the final revision of these and the final ten chapters to be made available as of September 1, 1971.

There will be two other outcomes of this project. The first will be a one-semester tenth grade course intended for students who have been through the junior high school sequence and intend to continue in mathematics. This course will prepare students for any standard eleventh grade mathematics text, in particular for the SMSG text "Intermediate Mathematics."

The final output of this project will be an issue of the SMSG Newsletter containing descriptions of a large variety of high school mathematics courses and sequences which could follow the tenth grade transitional course, together with references to appropriate text materials for all of these.

Separate order forms appear at the end of this Newsletter for "Secondary School Mathematics – Sample Chapters" and for the revised booklets for classroom use starting September 1, 1970.

# BRIEF DESCRIPTIONS OF SMSG PUBLICATIONS

## HIGH SCHOOL TEXTBOOKS

These texts are designed for average and above average students in a college preparatory program.

The first four texts listed below were produced simultaneously and hence no one of them presupposes that students using them had studied anything other than a conventional curriculum previously. Newsletter 25 will be of interest to teachers planning to use any of these texts.

The remaining texts on the list below were prepared after the first five and, in general, do take account of the earlier SMSG texts.

The *Programed Algebra* text has a separate response booklet so the text is reusable. *Geometry With Coordinates* is designed as an alternative to *Geometry*, putting more emphasis on analytic geometry. *Matrix Algebra* and *Analytic Geometry* are intended for students who have completed the prerequisites for calculus but wish to postpone study of this subject until college.

*Algorithms, Computation, and Mathematics* is a one semester course intended for the last year of high school. It is concerned with mathematical concepts which are fundamental to computer science. The text itself does not require a specific programing language and two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL.

*Calculus* appears in three parts. The first two together constitute a normal one year course and cover, for example, the CEEB Calculus BC advanced placement syllabus. Part three, which is available separately, takes up supplementary topics, mainly applications of calculus to the physical sciences.

*Calculus of Elementary Functions* interweaves the content of *Elementary Functions* with an introduction to differential and integral calculus. It is designed to cover the Calculus AB syllabus of the College Board advanced placement examination.

Each text is accompanied by an extensive teacher's commentary.

*First Course in Algebra*
*Geometry*
*Intermediate Mathematics*
*Elementary Functions*

*Introduction to Matrix Algebra*
*Programed First Course in Algebra*
*Geometry with Coordinates*
*Analytic Geometry*
*Algorithms, Computation, and Mathematics*
*Calculus*
*Calculus of Elementary Functions*

## JUNIOR HIGH SCHOOL TEXTS

These texts renew and extend the mathematics of the elementary school in such a way as to provide a sound intuitive foundation for high school courses. A considerable amount of informal geometry is included.

These texts were prepared for students who had only a conventional mathematics program in elementary school. Teachers using these texts with students who have had a more modern elementary program will be interested in Newsletter No. 25.

Sample chapters of a new junior high school mathematics program are available for inspection. This new program was described in Newsletter No. 24.

*Mathematics for Junior High School, Volume I*
*Mathematics for Junior High School, Volume II*

## TEXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in the texts for grades 7–9 listed above. However, the level of reading difficulty has been reduced to make them more suitable for students who are slightly below average in ability. It is expected that such students will proceed through these materials at a reduced rate.

Report No. 5 deals with a study of the use of these texts with students in the 25th to 50th percentile in aptitude.

Each text is accompanied by an extensive teacher's commentary.

*Introduction to Secondary School Mathematics, Volume I*
*Introduction to Secondary School Mathematics, Volume II*
*Introduction to Algebra*

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4–6 presuppose a conventional program through grade 3. Teachers using these texts with students who have had a more modern primary school program will be interested in Newsletter No. 28. The emphasis in all these texts is similar to that of the Junior High School texts.

In the teacher's commentary for each text all pages of the student text are reproduced. For kindergarten there is only a teacher's book.

*Mathematics for the Elementary School, Book K (Teacher's Commentary only)*
*Mathematics for the Elementary School, Book 1*
*Mathematics for the Elementary School, Book 2*
*Mathematics for the Elementary School, Book 3*
*Mathematics for the Elementary School, Grade 4*
*Mathematics for the Elementary School, Grade 5*
*Mathematics for the Elementary School, Grade 6*

## MATHEMATICS FOR CULTURALLY DISADVANTAGED CHILDREN

Special editions of the teacher's commentary for kindergarten and for grade one as well as the student work book for grade one have been prepared for use with culturally disadvantaged children. Studies in Mathematics, Volume 13 (listed below), is designed for use in in-service courses for teachers planning to use these materials.

Reports No. 2 and 4 will be of interest to those contemplating use of these materials.

The last item on the list below is a booklet which describes a number of activities appropriate for pre-school programs and designed to prepare young children for the kind of kindergarten and first grade mathematics program which SMSG has suggested.

*Mathematics for the Elementary School, Book K, Special Edition*
*Mathematics for the Elementary School, Book 1, Special Edition*
*Developing Mathematics Readiness in Pre-School Programs*

## SUPPLEMENTARY MATERIALS

A variety of booklets is available. Their common characteristic is that each requires less than a full academic year.

The first three of the following booklets use simple experiments from physical science to introduce and motivate mathematical ideas. They are designed for grades seven, eight, and nine. The later booklets do not presuppose study of the earlier ones.

The fourth booklet below parallels *Mathematics Through Science, Part 2*, but uses simple experiments from biological science rather than physical science.

*Mathematics Through Science, Part 1*
*Mathematics Through Science, Part 2*
*Mathematics Through Science, Part 3*
*Mathematics and Living Things*

The next booklet contains material not included in the textbooks for grades seven and eight and is designed for abler students.

*Junior High School Supplementary Unit*

The next two booklets are designed for outside reading by students in grades nine through twelve.

*Essays on Number Theory I*
*Essays on Number Theory II*

The following booklet, based on the first chapter of "Intermediate Mathematics" provides a review of the structural properties of the real number system and of its subsystems.

*Development of the Real Number System*

## PROBABILITY UNITS

Two pamphlets on probability have been prepared, one for the primary grades and one for the intermediate elementary school grades. A classroom set of spinners is available for use with each of these.

A programed short text on probability for use in junior high school is also available and a second programed text, presupposing the first and probably more suitable for senior high school, is also available.

*Probability for Primary Grades*
*Probability for Intermediate Grades*
*Introduction to Probability, Part I*
  *Basic Concepts*
*Introduction to Probability, Part II*
  *Special Topics*

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets are designed to allow teachers to try short modern treatments of particular mathematics topics in class. Some, however, are designed for independent study or enrichment. Teacher's commentaries are available for some of these.

*Functions*
*Circular Functions*
*The Complex Number System*
*The System of Vectors*
*Non-Metric Geometry*

*Plane Coordinate Geometry*
*Inequalities*
*Numeration*
*Algebraic Structures*
*Factors and Primes*
*Mathematical Systems*
*Systems of First Degree Equations in Three Variables*
*Radioactive Decay*
*Absolute Value*
*Mathematical Theory of the Struggle for Life*
*1 + 1 =?*
*Order and The Real Numbers: A Guided Tour*
*The Mathematics of Trees and Other Graphs*

**REPRINT SERIES**

Each of these pamphlets is devoted to a particular topic in mathematics and contains reprints of articles selected from a variety of journals.

*The Structure of Algebra*
*Prime Numbers and Perfect Numbers*
*What is Contemporary Mathematics?*
*Mascheroni Constructions*
*Space, Intuition and Geometry*
*Nature and History of Pi*
*Computation of Pi*
*Mathematics and Music*
*The Golden Measure*
*Geometric Constructions*
*Memorable Personalities in Mathematics: Nineteenth Century*
*Memorable Personalities in Mathematics: Twentieth Century*
*Finite Geometry*
*Infinity*
*Geometry, Measurement and Experience*

**SPANISH TRANSLATIONS**

Some of the texts listed below have been translated into Spanish for use in Puerto Rico. Translations of the teacher's commentaries are also available in some cases. The teacher's commentaries, but not the student texts, for grades 4, 5, and 6 have also been translated, as have been three volumes for teachers from the Studies in Mathematics series.

*Matematicas Para El Primer Ciclo Secundario, Volumen I*
*Matematicas Para El Primer Ciclo Secundario, Volumen II*
*Matematicas Para La Escuela Secundaria, Primer Curso de Algebra*
*Matematicas Para La Escuela Secundaria, Geometria*

*Matematicas Para La Escuela Secundaria,*
*Matematica Intermedia*
*Matematicas Para La Escuela Secundaria,*
*Introducción Al Algebra De Las Matrices*
*Matematicas Para La Escuela Secundaria,*
*Funciones Elementales*
*Geometria Analitica*
*Matematicas Para La Escuela Primaria,*
*Grado 4, Comentario*
*Matematicas Para La Escuela Primaria,*
*Grado 5, Comentario*
*Matematicas Para La Escuela Primaria,*
*Grado 6, Comentario*
*Conceptos De Geometria Intuitiva*
*El Curso Conciso En Matematicas Para Los*
*Profesores De Escuela Primaria*
*Introducción A Sistemas Numéricos*

## STUDIES IN MATHEMATICS

The books in this series are all intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

*Euclidean Geometry Based on*
*Ruler and Protractor Axioms*
*Structure of Elementary Algebra*
*Geometry*
*Concepts of Informal Geometry*
*Number Systems*
*Intuitive Geometry*
*Concepts of Algebra*
*Brief Course in Mathematics for*
*Elementary School Teachers*
*Applied Mathematics in the High School*
*Mathematical Methods in Science*
*Brief Course for Junior High School*
*Teachers*
*Inservice Course for Primary School Teachers*
*Introduction to Number Systems*
*Calculus and Science*
*Some Uses of Mathematics*
*Mathematical Concepts of Elementary*
*Measurement*
*Puzzle Problems and Games Project*
*Reviews of Recent Research in Mathematics*
*Education*

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were held to acquaint teachers with the contents and objectives of SMSG texts. Others were devoted to discussions of problems in mathematics education and the role of SMSG in attacking these problems.

*Elementary School Mathematics*
*Orientation Conference for SMSG Experimental Centers*
*Orientation Conference for SMSG Elementary School Experimental Centers*
*Orientation Conference for Geometry with Coordinates*
*Future Responsibilities for School Mathematics*
*Mathematics Education for Below Average Achievers*
*A Conference on Mathematics For Gifted Students*

## NEW MATHEMATICAL LIBRARY

This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

The authors of these monographs are mathematicians interested and well versed in the fields they treat.

A trade edition of these monographs is available through Random House. In addition, a special edition is available only to high school students and teachers at a reduced rate from the L. W. Singer Co. An order form appears on page 30.

*Niven — Numbers: Rational and Irrational (NML-1)*
*Sawyer — What is Calculus About? (NML-2)*
*Beckenbach and Bellman — An Introduction to Inequalities (NML-3)*
*Kazarinoff — Geometric Inequalities (NML-4)*
*Davis — The Lore of Large Numbers (NML-6)*
*Zippin — Uses of Infinity (NML-7)*
*Yaglom — Geometric Transformations I (NML-8)*
*Olds — Continued Fractions (NML-9)*
*Ore — Graphs and Their Uses (NML-10)*
*Hungarian Problem Book I (NML-11)*
*Hungarian Problem Book II (NML-12)*
*Aaboe — Episodes from the Early History of Mathematics (NML-13)*
*Grossman and Magnus — Groups and their Graphs (NML-14)*
*Niven — Mathematics of Choice (NML-15)*
*Friedrichs — From Pythagoras to Einstein (NML-16)*

*Contest Problem Book II (NML-17)*
*Chinn and Steenrod — First Concepts of Topology (NML-18)*
*Coxeter and Greitzer — Geometry Revisited (NML-19)*
*Ore — Invitation to Number Theory (NML-20)*
*Yaglom — Geometric Transformations II (NML-21)*
*Sinkov — Elementary Cryptanalysis (NML-22)*

## NLSMA REPORTS

The first six reports reproduce the test batteries used in a five year longitudinal study of mathematics achievement and provide statistical information on the various scales contained in these batteries. Report 9 contains information about the schools, communities, and teachers involved in the study.

*NLSMA Report No. 1 (Parts A and B): X Population Test Batteries*
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| | Aaboe — Episodes from the Early History of Mathematics (NML-13) | $1.29 | |
| | Grossman and Magnus — Groups and their Graphs (NML-14) | $1.29 | |
| | Niven — Mathematics of Choice (NML-15) | $1.29 | |
| | Friedrichs — From Pythagoras to Einstein (NML-16) | $1.29 | |
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| | Ore — Invitation to Number Theory (NML-20) | $1.29 | |
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# Newsletter No. 34

*March 1971*

## SMSG Publications

1/2

# NEW PUBLICATIONS

## SECONDARY SCHOOL

In SMSG Newsletter No. 24, October 1966, there appeared a preliminary announcement of a new SMSG curriculum project. The major outcome from this project will be a new junior high school mathematics curriculum.

Distinguishing characteristics of this new curriculum are:

(1) the usual grade placement of mathematical topics is ignored; instead, topics from arithmetic, algebra, and geometry are introduced in a logical sequence and in such a way as to provide mutual support.

(2) this curriculum is devoted solely to those mathematical concepts which the SMSG planning and writing groups believe all citizens should know in order to function effectively in our society.

(3) certain topics new to the junior high school program are included; in particular, probability, statistics, and flow charts.

(4) a strong attempt is made to make clear to the students the relevance of mathematics to problems of the real world.

Classroom tryouts of preliminary versions of many of the chapters indicate that, once teachers are familiar with the new curriculum, most college-capable students should be able to complete this curriculum in three years, i.e., by the end of grade 9. It is presumed that less able students will be able to cover the same material, but over a longer stretch of time.

By the end of the summer of 1971 final revisions of all 28 chapters of this new sequence will have been finished, and the entire sequence will be available for general use.

In addition, a one-semester tenth grade course will be made available. This course is designed for those students who have completed the new junior high school sequence and who wish to study further mathematics. This new text will cover certain topics in formal algebra and geometry not included in the junior high school sequence but prerequisite to the mathematics normally studied in grades 11 and 12. Students completing this text will be able to move without difficulty into the SMSG text "Intermediate Mathematics."

A special revision of some of the early chapters in the junior high school sequence has been prepared for students whose achievement in mathematics during elementary school was very low. A description of this special version appeared in SMSG Newsletter No. 33. Ten additional chapters will be revised in summer of 1971 and made available for classroom use for the 1971-72 school year.

## ELEMENTARY SCHOOL

One of the most distinctive characteristics of the SMSG elementary school texts is the early introduction of informal geometric ideas and the substantial amount of the K-6 program devoted to geometry. At the request of many elementary school teachers, principals, and curriculum consultants, the geometry chapters from the SMSG elementary school texts are now made available as a set of separate units.

These are not to be thought of as a course in geometry for the elementary school. Rather they are intended to be used as supplements to presently existing elementary school mathematics curricula. Which units will be useful for the purpose, and at what times, will depend on the backgrounds of the students and the objectives of the mathematics program in the particular school.

A teacher's commentary is available for each chapter.

# BRIEF DESCRIPTIONS OF SMSG PUBLICATIONS

## HIGH SCHOOL TEXTBOOKS

These texts are designed for average and above average students in a college preparatory program.

The first four texts listed below were produced simultaneously and hence no one of them presupposes that students using them had studied anything other than a conventional curriculum previously. Newsletter 25 will be of interest to teachers planning to use any of these texts.

The remaining texts on the list below were prepared after the first five and, in general, do take account of the earlier SMSG texts.

The *Programed Algebra* text has a separate response booklet so the text is reusable. *Geometry With Coordinates* is designed as an alternative to *Geometry*, putting more emphasis on analytic geometry. *Matrix Algebra* and *Analytic Geometry* are intended for students who have completed the prerequisites for calculus but wish to postpone study of this subject until college.

*Algorithms, Computation, and Mathematics* is a one semester course intended for the last year of high school. It is concerned with mathematical concepts which are fundamental to computer science. The text itself does not require a specific programing language and two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL.

*Calculus* appears in three parts. The first two together constitute a normal one year course and cover, for example, the CEEB Calculus BC advanced placement syllabus. Part three, which is available separately, takes up supplementary topics, mainly applications of calculus to the physical sciences.

*Calculus of Elementary Functions* interweaves the content of *Elementary Functions* with an introduction to differential and integral calculus. It is designed to cover the Calculus AB syllabus of the College Board advanced placement examination.

*Transition Course* is the one-semester 10th grade course designed to bridge the gap between the new junior high school course, *Secondary School Mathematics*, and the 11th and 12th grade SMSG texts.

Each text is accompanied by an extensive teacher's commentary.

*First Course in Algebra*
*Geometry*
*Intermediate Mathematics*
*Elementary Functions*
*Introduction to Matrix Algebra*
*Programed First Course in Algebra*
*Geometry with Coordinates*
*Analytic Geometry*
*Algorithms, Computation, and Mathematics*
*Calculus*
*Calculus of Elementary Functions*
*Transition Course*

## JUNIOR HIGH SCHOOL TEXTS

These texts renew and extend the mathematics of the elementary school in such a way as to provide a sound intuitive foundation for high school courses. A considerable amount of informal geometry is included.

These texts were prepared for students who had only a conventional mathematics program in elementary school. Teachers using these texts with students who have had a more modern elementary program will be interested in Newsletter No. 25.

*Secondary School Mathematics* is a new curriculum for grades 7 through 9 in which the sequence in which topics appear is considerably different from that of the past.

*Mathematics for Junior High School,*
  *Volume I*
*Mathematics for Junior High School,*
  *Volume II*
*Secondary School Mathematics*

## TEXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in the texts for grades 7–9 listed above. However, the level of reading difficulty has been reduced to make them more suitable for students who are slightly below average in ability. It is expected that such students will proceed through these materials at a reduced rate.

Report No. 5 deals with a study of the use of these texts with students in the 25th to 50th percentile in aptitude.

Each text is accompanied by an extensive teacher's commentary.

*Secondary School Mathematics, Special Edition,* is a specially prepared version of some of the early chapters of *Secondary School Mathematics,* explicitly designed for 7th and 8th grade students whose achievement in mathematics in elementary school was very low.

*Introduction to Secondary School Mathematics, Volume I*
*Introduction to Secondary School Mathematics, Volume II*
*Introduction to Algebra*
*Secondary School Mathematics, Special Edition*

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4–6 presuppose a conventional program through grade 3. Teachers using these texts with students who have had a more modern primary school program will be interested in Newsletter No. 28. The emphasis in all these texts is similar to that of the Junior High School texts.

In the teacher's commentary for each text all pages of the student text are reproduced. For kindergarten there is only a teacher's book.

*Mathematics for the Elementary School, Book K (Teacher's Commentary only)*
*Mathematics for the Elementary School, Book 1*
*Mathematics for the Elementary School, Book 2*
*Mathematics for the Elementary School, Book 3*
*Mathematics for the Elementary School, Grade 4*
*Mathematics for the Elementary School, Grade 5*
*Mathematics for the Elementary School, Grade 6*

## MATHEMATICS FOR CULTURALLY DISADVANTAGED CHILDREN

Special editions of the teacher's commentary for kindergarten and for grade one as well as the student work book for grade one have been prepared for use with culturally disadvantaged children. Studies in Mathematics, Volume 13 (listed below), is designed for use in in-service courses for teachers planning to use these materials.

Reports No. 2 and 4 will be of interest to those contemplating use of these materials.

The last item on the list below is a booklet which describes a number of activities appropriate for pre-school programs and designed to prepare young children for the kind of kindergarten and first grade mathematics program which SMSG has suggested.

*Mathematics for the Elementary School, Book K, Special Edition*

*Mathematics for the Elementary School, Book I, Special Edition*

*Developing Mathematics Readiness in Pre-School Programs*

## SUPPLEMENTARY MATERIALS

A variety of booklets is available. Their common characteristic is that each requires less than a full academic year.

The first three of the following booklets use simple experiments from physical science to introduce and motivate mathematical ideas. They are designed for grades seven, eight, and nine. The later booklets do not presuppose study of the earlier ones.

The fourth booklet below parallels *Mathematics Through Science, Part 2*, but uses simple experiments from biological science rather than physical science.

*Mathematics Through Science, Part 1*

*Mathematics Through Science, Part 2*

*Mathematics Through Science, Part 3*

*Mathematics and Living Things*

The next booklet contains material not included in the textbooks for grades seven and eight and is designed for abler students.

*Junior High School Supplementary Unit*

The next two booklets are designed for outside reading by students in grades nine through twelve.

*Essays on Number Theory I*

*Essays on Number Theory II*

The following booklet, based on the first chapter of "Intermediate Mathematics" provides a review of the structural properties of the real number system and of its subsystems.

*Development of the Real Number System*

## PROBABILITY UNITS

Two pamphlets on probability have been prepared, one for the primary grades and one for the intermediate elementary school grades. A classroom set of spinners is available for use with each of these.

A programed short text on probability for use in junior high school is also available and a second programed text, presupposing the first and probably more suitable for senior high school, is also available.

*Probability for Primary Grades*

*Probability for Intermediate Grades*

*Introduction to Probability, Part I*
*Basic Concepts*

*Introduction to Probability, Part II*
*Special Topics*

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets are designed to allow teachers to try short modern treatments of particular mathematics topics in class. Some, however, are designed for independent study or enrichment. Teacher's commentaries are available for some of these.

*Functions*
*Circular Functions*
*The Complex Number System*
*The System of Vectors*
*Non-Metric Geometry*
*Plane Coordinate Geometry*
*Inequalities*
*Numeration*
*Algebraic Structures*
*Factors and Primes*
*Mathematical Systems*
*Systems of First Degree Equations in Three Variables*
*Radioactive Decay*
*Absolute Value*
*Mathematical Theory of the Struggle for Life*
*1 + 1 = ?*
*Order and The Real Numbers: A Guided Tour*
*The Mathematics of Trees and Other Graphs*

## REPRINT SERIES

Each of these pamphlets is devoted to a particular topic in mathematics and contains reprints of articles selected from a variety of journals.

*The Structure of Algebra*
*Prime Numbers and Perfect Numbers*
*What is Contemporary Mathematics?*
*Mascheroni Constructions*
*Space, Intuition and Geometry*
*Nature and History of Pi*
*Computation of Pi*
*Mathematics and Music*
*The Golden Measure*
*Geometric Constructions*
*Memorable Personalities in Mathematics: Nineteenth Century*
*Memorable Personalities in Mathematics: Twentieth Century*
*Finite Geometry*
*Infinity*
*Geometry, Measurement and Experience*

## SPANISH TRANSLATIONS

Some of the texts listed below have been translated into Spanish for use in Puerto Rico. Translations of the teacher's commentaries are also available in some cases. The teacher's commentaries, but not the student texts, for grades 4, 5, and 6 have also been translated, as have been three volumes for teachers from the Studies in Mathematics series.

*Matematicas Para El Primer Ciclo Secundario, Volumen I*
*Matematicas Para El Primer Ciclo Secundario, Volumen II*
*Matematicas Para La Escuela Secundaria, Primer Curso de Algebra*
*Matematicas Para La Escuela Secundaria, Geometria*
*Matematicas Para La Escuela Secundaria, Matematica Intermedia*
*Matematicas Para La Escuela Secundaria, Introducción Al Algebra De Las Matrices*
*Matematicas Para La Escuela Secundaria, Funciones Elementales*
*Geometria Analitica*
*Matematicas Para La Escuela Primaria, Grado 4, Comentario*
*Matematicas Para La Escuela Primaria, Grado 5, Comentario*
*Matematicas Para La Escuela Primaria, Grado 6, Comentario*
*Conceptos De Geometria Intuitiva*
*El Curso Conciso En Matematicas Para Los Profesores De Escuela Primaria*
*Introducción A Sistemas Numéricos*

## STUDIES IN MATHEMATICS

The books in this series are all intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

*Euclidean Geometry Based on Ruler and Protractor Axioms*
*Structure of Elementary Algebra*
*Geometry*
*Concepts of Informal Geometry*
*Number Systems*
*Intuitive Geometry*
*Concepts of Algebra*
*Brief Course in Mathematics for Elementary School Teachers*
*Applied Mathematics in the High School*
*Mathematical Methods in Science*
*Brief Course for Junior High School Teachers*
*Inservice Course for Primary School Teachers*
*Introduction to Number Systems*
*Calculus and Science*
*Some Uses of Mathematics*

*Mathematical Concepts of Elementary Measurement*
*Puzzle Problems and Games Project*
*Reviews of Recent Research in Mathematics Education*

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were held to acquaint teachers with the contents and objectives of SMSG texts. Others were devoted to discussions of problems in mathematics education and the role of SMSG in attacking these problems.

*Elementary School Mathematics*
*Orientation Conference for SMSG Experimental Centers*
*Orientation Conference for SMSG Elementary School Experimental Centers*
*Orientation Conference for Geometry with Coordinates*
*Future Responsibilities for School Mathematics*
*Mathematics Education for Below Average Achievers*
*A Conference on Mathematics For Gifted Students*
*A Conference on Mathematics Education in the Inner City Schools*
*A Conference on Responsibilities for School Mathematics in the 70's*

## NEW MATHEMATICAL LIBRARY

This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

The authors of these monographs are mathematicians interested and well versed in the fields they treat.

A trade edition of these monographs is available through Random House. In addition, a special edition is available only to high school students and teachers at a reduced rate from the L. W. Singer Co. An order form appears on page 30.

*Niven — Numbers: Rational and Irrational (NML-1)*
*Sawyer — What is Calculus About? (NML-2)*

*Beckenbach and Bellman — An Introduction to Inequalities (NML-3)*
*Kazarinoff — Geometric Inequalities (NML-4)*
*Davis — The Lore of Large Numbers (NML-6)*
*Zippin — Uses of Infinity (NML-7)*
*Yaglom — Geometric Transformations I (NML-8)*
*Olds — Continued Fractions (NML-9)*
*Ore — Graphs and Their Uses (NML-10)*
*Hungarian Problem Book I (NML-11)*
*Hungarian Problem Book II (NML-12)*
*Aaboe — Episodes from the Early History of Mathematics (NML-13)*
*Grossman and Magnus — Groups and their Graphs (NML-14)*
*Niven — Mathematics of Choice (NML-15)*
*Friedrichs — From Pythagoras to Einstein (NML-16)*
*Contest Problem Book II (NML-17)*
*Chinn and Steenrod — First Concepts of Topology (NML-18)*
*Coxeter and Greitzer — Geometry Revisited (NML-19)*
*Ore — Invitation to Number Theory (NML-20)*
*Yaglom — Geometric Transformations II (NML-21)*
*Sinkov — Elementary Cryptanalysis (NML-22)*
*Honsberger — Ingenuity in Mathematics (NML-23)*

## NLSMA REPORTS

The first six reports reproduce the test batteries used in a five year longitudinal study of mathematics achievement and provide statistical information on the various scales contained in these batteries. Report 9 contains information about the schools, communities, and teachers involved in the study.

*NLSMA Report No. 1 (Parts A and B): X Population Test Batteries*
*NLSMA Report No. 2 (Parts A and B): Y-Population Test Batteries*
*NLSMA Report No. 3: Z-Population Test Batteries*
*NLSMA Report No. 4: Description and Statistical Properties of X-Population Scales*
*NLSMA Report No. 5: Description and Statistical Properties of Y-Population Scales*
*NLSMA Report No. 6: Description and Statistical Properties of Z-Population Scales*
*NLSMA Report No. 7: The Development of Tests*
*NLSMA Report No. 9: Non-Test Data*

*NLSMA Report No. 10: Patterns of Mathematics Achievement in Grades 4, 5, and 6: X-Population*
*NLSMA Report No. 11: Patterns of Mathematics Achievement in Grades 7 and 8: X-Population*
*NLSMA Report No. 12: Patterns of Mathematics Achievement in Grades 7 and 8: Y-Population*
*NLSMA Report No. 13: Patterns of Mathematics Achievement in Grade 9: Y-Population*
*NLSMA Report No. 14: Patterns of Mathematics Achievement in Grade 10: Y-Population*

## SOVIET STUDIES IN THE PSYCHOLOGY OF LEARNING AND TEACHING MATHEMATICS

Each volume in the series contains one or more articles under a general heading, such as the learning of mathematical concepts, the structure of mathematical abilities, or methods of teaching mathematics. The articles form neither a random nor even a representative sample of the entire Soviet literature. Instead, the editors have chosen, from publications available to the Survey of Recent East European Mathematical Literature at the University of Chicago, articles that illustrate some of the most interesting aspects of recent Soviet pedagogical theory and research.

*Volume I: The Learning of Mathematical Concepts*
*Volume II: The Structure of Mathematical Abilities*
*Volume III: Problem Solving in Arithmetic and Algebra*
*Volume IV: Problem Solving in Geometry*

## INVESTIGATIONS IN MATHEMATICS EDUCATION

This journal will contain abstracts of published research reports dealing with mathematics education. Each abstract includes an objective indication of the (1) purpose, (2) rationale, (3) research design and procedure, (4) findings, and (5) the investigator's interpretation of the findings – insofar as the information has been included in the research report.

In addition, each abstracter is given an opportunity to comment upon or raise questions about the research report for which he prepares an abstract.

The first issue of this journal contains abstracts of 16 research reports published during the first half of 1968. No fixed schedule has yet been set for later issues, but it is hoped that two issues can be prepared each year.

No subscriptions to this journal can be accepted. However, a mailing list will be maintained at SMSG Headquarters and each person on the list will be notified by postcard whenever a new volume of this journal is published. Requests for inclusion on this mailing list should be addressed to:

SMSG, Cedar Hall
Stanford University
Stanford, Calif. 94305

*A Journal of Abstracts and Annotations*
*Volumes I, II, and III*

## MISCELLANEOUS PUBLICATIONS

*Very Short Course in Mathematics for Parents*

This booklet is designed to give parents (and other interested persons) a chance to work through a small sample of "modern" mathematics and thus to see more clearly how and in what ways the "modern" treatment differs from the traditional.

*Philosophies and Procedures of SMSG Writing Teams*

Brief accounts of the philosophies developed by SMSG writing teams and the procedures used in preparing the SMSG texts.

*SMSG: The Making of a Curriculum, By William Wooton*

This book records the activities of the School Mathematics Study Group from 1958 to 1962.

## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

This course consists of thirty half-hour color films. The series is intended primarily for inservice elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementary school mathematics programs. The series is mathematical in content but no mathematical prerequisites are presumed. Studies in Mathematics, Vol. 9, is designed to accompany this filmed course.

The first sixteen of these films provide a suitable background in mathematics for teachers of grades K–3. The remainder, building on these, are concerned with mathematics normally taught in grades 4–6.

The distributor for these films is Modern Learning Aids, 1212 Avenue of the Americas, New York, New York 10036. Distribution will be from the following five locations: 160 E. Grand Avenue, Chicago, Illinois 60611; 1411 Slocum Street, Dallas, Texas 75207; 714 Spring Street, N.W., Atlanta, Georgia 30308; 1145 North MacCadden Place, Los Angeles, California 90038; and 315 Springfield Avenue, Summit, New Jersey 07901.

## NEWSLETTERS

In order to keep the mathematical community informed, an SMSG Newsletter is published from time to time. A postcard request is sufficient for one to be placed on the mailing list.

The following issues are still available in limited quantities from: SMSG – Cedar Hall, Stanford University, Stanford, California 94305.

Newsletter No. 15 – Reports
Newsletter No. 17 – Panel on Supplementary Publications
Newsletter No. 19 – Report of a Survey of Inservice Programs for Mathematics Teachers
Newsletter No. 21 – The New Mathematical Library
Newsletter No. 23 – Panel on Supplementary Publications
Newsletter No. 24 – General Information
Newsletter No. 25 – Articulation of Content of SMSG Texts Grades 7–10
Newsletter No. 28 – Articulation of Content of SMSG Texts Grades 1–3 and Grade 4
Newsletter No. 30 – Status Reports and Recent Publications
Newsletter No. 33 – Mathematics for Disadvantaged and Low Achieving Students

## REPORTS

This series consists of reports, too long to be included in SMSG Newsletters, on various SMSG projects. Single copies may be obtained by a postcard request to SMSG, Cedar Hall, Stanford University, Stanford, California 94305.

1. *The SMSG Programed Learning Project*
2. *The Special Curriculum Project*
3. *A Film-Film Text Study*
4. *The Special Curriculum Project: 1965–66*
5. *The Slow Learner Project: The Secondary School "Slow Learner" in Mathematics*
6. *Preliminary Report on an Experiment with Junior High School Very Low Achievers in Mathematics*

7. *Final Report on an Experiment with Junior High School Very Low Achievers in Mathematics*
8. *The Mathematics Through Science Study: Attitude Changes in a Mathematics Laboratory*

# ORDER INFORMATION

1. Accredited schools will be given an educational discount of 30%. Shipping charges will be billed to the purchaser.

2. Other institutions or individuals interested in mathematics education will be given an educational discount of 30% on orders totaling $10 or more. Shipping charges will be billed to the purchaser.

3. Orders totaling less than $10, and not from accredited schools, will be billed at list price, but shipping charges by book post will be paid by A. C. Vroman.

4. Orders from individuals should be accompanied by remittance, including 5% sales tax on orders originating in California.

5. Orders from overseas accounts which have not established credit should be accompanied by remittance.

6. We regret that we are unable to supply free desk and examination copies.

7. Returns may **not** be made without prior permission.

8. We believe that it is vital to the success of the individual student as well as to the planned curriculum of the entire class, that Teacher's Commentaries not be sent by us to students. We therefore request that teachers ordering Commentaries for examination please do so on school stationery or in some other way to indicate professional status.

9. As it takes longer to process an order during the rush period in July, August, and September, we urgently suggest that you place your order well in advance of your needs. Orders will be shipped on a first come, first served basis.

10. All correspondence concerning orders should be addressed to:

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| | Teacher's Commentary | $1.00 | |
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Two separate editions of the **New Mathematical Library** are now available.

A trade edition is published by Random House, Inc. Each volume in this edition is priced at $1.95. This edition is available in book stores or may be ordered by mail from:

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| | Sawyer — What is Calculus About? (NML-2) | $1.95 | |
| | Beckenbach and Bellman — An Introduction to Inequalities (NML-3) | $1.95 | |
| | Kazarinoff — Geometric Inequalities (NML-4) | $1.95 | |
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SCHOOL
MATHEMATICS
STUDY GROUP

# Newsletter No. 37

*March 1972*

## SMSG Publications

## BRIEF DESCRIPTIONS OF SMSG PUBLICATIONS

### HIGH SCHOOL TEXTBOOKS

These texts are designed for average and above average students in a college preparatory program.

The first four texts listed below were produced simultaneously and hence no one of them presupposes that students using them had studied anything other than a conventional curriculum previously. Newsletter 25 will be of interest to teachers planning to use any of these texts.

The remaining texts on the list below were prepared after the first five and, in general, do take account of the earlier SMSG texts.

The *Programed Algebra* text has a separate response booklet so the text is reusable. *Geometry With Coordinates* is designed as an alternative to *Geometry*, putting more emphasis on analytic geometry. *Matrix Algebra* and *Analytic Geometry* are intended for students who have completed the prerequisites for calculus but wish to postpone study of this subject until college.

*Algorithms, Computation, and Mathematics* is a one semester course intended for the last year of high school. It is concerned with mathematical concepts which are fundamental to computer science. The text itself does not require a specific programing language and two supplementary texts are available, one devoted to FORTRAN and the other to ALGOL.

*Calculus* appears in three parts. The first two together constitute a normal one year course and cover, for example, the CEEB Calculus BC advanced placement syllabus. Part three, which is available separately, takes up supplementary topics, mainly applications of calculus to the physical sciences.

*Calculus of Elementary Functions* interweaves the content of *Elementary Functions* with an introduction to differential and integral calculus. It is designed to cover the Calculus AB syllabus of the College Board advanced placement examination.

*Secondary School Advanced Mathematics* is the title of the transition course designed to bridge the gap between the new junior high school course, *Secondary School Mathematics*, and the 11th and 12th grade SMSG texts.

Each text is accompanied by an extensive teacher's commentary.

*First Course in Algebra*
*Geometry*
*Intermediate Mathematics*
*Elementary Functions*
*Introduction to Matrix Algebra*
*Programed First Course in Algebra*
*Geometry with Coordinates*
*Analytic Geometry*
*Algorithms, Computation, and Mathematics*
*Calculus*
*Calculus of Elementary Functions*
*Secondary School Advanced Mathematics*

## JUNIOR HIGH SCHOOL TEXTS

These texts renew and extend the mathematics of the elementary school in such a way as to provide a sound intuitive foundation for high school courses. A considerable amount of informal geometry is included.

These texts were prepared for students who had only a conventional mathematics program in elementary school. Teachers using these texts with students who have had a more modern elementary program will be interested in Newsletter No. 25.

*Secondary School Mathematics* is a new curriculum for grades 7 through 9 in which the sequence in which topics appear is considerably different from that of the past.

In view of the availability of *Secondary School Mathematics*, the original junior high school texts will be phased out over the next few years. Volume I will not be reprinted after September 1, 1972.

*Mathematics for Junior High School, Volume I*
*Mathematics for Junior High School, Volume II*
*Secondary School Mathematics*

## TEXTS FOR SLOWER STUDENTS

These texts include the bulk of the mathematics in the texts for grades 7–9 listed above. However, the level of reading difficulty has been reduced to make them more suitable for students who are slightly below average in ability. It is expected that such students will proceed through these materials at a reduced rate.

Report No. 5 deals with a study of the use of these texts with students in the 25th to 50th percentile in aptitude.

Each text is accompanied by an extensive teacher's commentary.

*Secondary School Mathematics, Special Edition,* is a specially prepared version of some of the early chapters of *Secondary School Mathematics,* explicitly designed for 7th and 8th grade students whose achievement in mathematics in elementary school was very low.

*Introduction to Secondary School Mathematics, Volume I*
*Introduction to Secondary School Mathematics, Volume II*
*Introduction to Algebra*
*Secondary School Mathematics, Special Edition*

## ELEMENTARY SCHOOL TEXTS

The texts for grades 4–6 presuppose a conventional program through grade 3. Teachers using these texts with students who have had a more modern primary school program will be interested in Newsletter No. 28. The emphasis in all these texts is similar to that of the Junior High School texts.

In the teacher's commentary for each text all pages of the student text are reproduced. For kindergarten there is only a teacher's book.

*Mathematics for the Elementary School, Book K (Teacher's Commentary only)*
*Mathematics for the Elementary School, Book 1*
*Mathematics for the Elementary School, Book 2*
*Mathematics for the Elementary School, Book 3*
*Mathematics for the Elementary School, Grade 4*
*Mathematics for the Elementary School, Grade 5*
*Mathematics for the Elementary School, Grade 6*

## MATHEMATICS FOR CULTURALLY DISADVANTAGED CHILDREN

Special editions of the teacher's commentary for kindergarten and for grade one as well as the student work book for grade one have been prepared for use with culturally disadvantaged children. Studies in Mathematics, Volume 13 (listed below), is designed for use in in-service courses for teachers planning to use these materials.

Reports No. 2 and 4 will be of interest to those contemplating use of these materials.

The last item on the list below is a booklet which describes a number of activities appropriate for pre-school programs and designed to prepare young children for the kind of kindergarten and first grade mathematics program which SMSG has suggested.

*Mathematics for the Elementary School, Book K, Special Edition*

*Mathematics for the Elementary School, Book I, Special Edition*

*Developing Mathematics Readiness in Pre-School Programs*

## SUPPLEMENTARY MATERIALS

A variety of booklets is available. Their common characteristic is that each requires less than a full academic year.

The first three of the following booklets use simple experiments from physical science to introduce and motivate mathematical ideas. They are designed for grades seven, eight, and nine. The later booklets do not presuppose study of the earlier ones.

The fourth booklet below parallels *Mathematics Through Science, Part 2*, but uses simple experiments from biological science rather than physical science.

*Mathematics Through Science, Part 1*
*Mathematics Through Science, Part 2*
*Mathematics Through Science, Part 3*
*Mathematics and Living Things*

The next booklet contains material not included in the textbooks for grades seven and eight and is designed for abler students.

*Junior High School Supplementary Unit*

The next two booklets are designed for outside reading by students in grades nine through twelve.

*Essays on Number Theory I*
*Essays on Number Theory II*

The following booklet, based on the first chapter of "Intermediate Mathematics" provides a review of the structural properties of the real number system and of its subsystems.

*Development of the Real Number System*

## PROBABILITY UNITS

Two pamphlets on probability have been prepared, one for the primary grades and one for the intermediate elementary school grades. A classroom set of spinners is available for use with each of these.

A programed short text on probability for use in junior high school is also available and a second programed text, presupposing the first and probably more suitable for senior high school, is also available.

*Probability for Primary Grades*
*Probability for Intermediate Grades*
*Introduction to Probability, Part I*
  *Basic Concepts*
*Introduction to Probability, Part II*
  *Special Topics*

## SUPPLEMENTARY AND ENRICHMENT SERIES

Most of these pamphlets were designed to allow teachers to try short modern treatments of particular mathematics topics in class and are no longer needed. Some, however, were designed for independent study or enrichment. These are still available.

*Algebraic Structures*
*Radioactive Decay*
*Mathematical Theory of the Struggle for Life*
*$1 + 1 = ?$*
*Order and The Real Numbers: A Guided Tour*
*The Mathematics of Trees and Other Graphs*

## REPRINT SERIES

Each of these pamphlets is devoted to a particular topic in mathematics and contains reprints of articles selected from a variety of journals.

*The Structure of Algebra*
*Prime Numbers and Perfect Numbers*
*What is Contemporary Mathematics?*
*Mascheroni Constructions*
*Space, Intuition and Geometry*
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  *Nineteenth Century*
*Memorable Personalities in Mathematics:*
  *Twentieth Century*
*Finite Geometry*
*Infinity*
*Geometry, Measurement and Experience*

## SPANISH TRANSLATIONS

Some of the texts listed below have been translated into Spanish for use in Puerto Rico. Translations of the teacher's commentaries are also available in some cases. The teacher's commentaries, but not the student texts, for grades 4, 5, and 6 have also been translated, as have been three volumes for teachers from the Studies in Mathematics series. These will be kept available until the present supply is exhausted and will not be reprinted.

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**STUDIES IN MATHEMATICS**

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*Some Uses of Mathematics*

*Mathematical Concepts of Elementary Measurement*
*Puzzle Problems and Games Project*
*Reviews of Recent Research in Mathematics Education*

## CONFERENCE REPORTS

These are reports of a variety of conferences sponsored by SMSG. Some of these conferences were held to acquaint teachers with the contents and objectives of SMSG texts. Others were devoted to discussions of problems in mathematics education and the role of SMSG in attacking these problems.

*Elementary School Mathematics*
*Orientation Conference for SMSG Experimental Centers*
*Orientation Conference for SMSG Elementary School Experimental Centers*
*Orientation Conference for Geometry with Coordinates*
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*A Conference on Mathematics Education in the Inner City Schools*
*A Conference on Responsibilities for School Mathematics in the 70's*

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This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

The authors of these monographs are mathematicians interested and well versed in the fields they treat.

A trade edition of these monographs is available through Random House. In addition, a special edition is available only to high school students and teachers at a reduced rate from the L. W. Singer Co. An order form appears on page 30.

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*Sawyer – What is Calculus About? (NML-2)*

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The first six reports reproduce the test batteries used in a five year longitudinal study of mathematics achievement and provide statistical information on the various scales contained in these batteries. Report 9 contains information about the schools, communities, and teachers involved in the study.

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## SOVIET STUDIES IN THE PSYCHOLOGY OF LEARNING AND TEACHING MATHEMATICS

Each volume in the series contains one or more articles under a general heading, such as the learning of mathematical concepts, the structure of mathematical abilities, or methods of teaching mathematics. The articles form neither a random nor even a representative sample of the entire Soviet literature. Instead, the editors have chosen, from publications available to the Survey of Recent East European Mathematical Literature at the University of Chicago, articles that illustrate some of the most interesting aspects of recent Soviet pedagogical theory and research.

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*Volume II: The Structure of Mathematical Abilities*

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## INVESTIGATIONS IN MATHEMATICS EDUCATION

This journal will contain abstracts of published research reports dealing with mathematics education. Each abstract includes an objective indication of the (1) purpose, (2) rationale, (3) research design and procedure, (4) findings, and (5) the investigator's interpretation of the findings – insofar as the information has been included in the research report.

In addition, each abstracter is given an opportunity to comment upon or raise questions about the research report for which he prepares an abstract.

The first issue of this journal contains abstracts of 16 research reports published during the first half of 1968. No fixed schedule has yet been set for later issues, but it is hoped that two issues can be prepared each year.

No subscriptions to this journal can be accepted. However, a mailing list will be maintained at SMSG Headquarters and each person on the list will be notified by postcard whenever a new volume of this journal is published. Requests for inclusion on this mailing list should be addressed to:

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*A Journal of Abstracts and Annotations*
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Brief accounts of the philosophies developed by SMSG writing teams and the procedures used in preparing the SMSG texts.

*SMSG: The Making of a Curriculum,*
*By William Wooton*
This book records the activities of the School Mathematics Study Group from 1958 to 1962.

## ELMA TECHNICAL REPORTS

These contain the tests and other measuring instruments used in the four year longitudinal study of primary school mathematics. Statistics, for the population involved, are included for each test.

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Grade 1 Test Batteries, Description and Statistical Properties of Scales
Grade 2 Test Batteries, Description and Statistical Properties of Scales
Grade 3 Test Batteries, Description and Statistical Properties of Scales

## ELMA REPORTS

These two volumes report the results of a four year longitudinal study of mathematics in grades K-3. Half the students involved were from minority groups.

Single copies of these reports may be obtained by a postcard request to SMSG, Cedar Hall, Stanford University, Stanford, California 94305.

1. *A Longitudinal Study of Mathematical Achievement in the Primary School Years: Description of Design, Sample, and Factor Analyses of Tests*
2. *A Longitudinal Study of Mathematical Achievement in the Primary School Years: Curriculum and Socio-Economic Comparisons and Predictions from Previous Achievement*

## FILMED COURSE FOR ELEMENTARY SCHOOL TEACHERS

This course consists of thirty half-hour color films. The series is intended primarily for inservice elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementary school mathematics programs. The series is mathematical in content but no mathematical prerequisites are presumed. Studies in Mathematics, Vol. 9, is designed to accompany this filmed course.

The first sixteen of these films provide a suitable background in mathematics for teachers of grades K–3. The remainder, building on these, are concerned with mathematics normally taught in grades 4–6.

The distributor for these films is Modern Learning Aids, 1212 Avenue of the Americas, New York, New York 10036. Distribution will be from the following five locations: 160 E. Grand Avenue, Chicago, Illinois 60611; 1411 Slocum Street, Dallas, Texas 75207; 714 Spring Street, N.W., Atlanta, Georgia 30308; 1145 North MacCadden Place, Los Angeles, California 90038; and 315 Springfield Avenue, Summit, New Jersey 07901.

## NEWSLETTERS

In order to keep the mathematical community informed, an SMSG Newsletter is published from time to time. A postcard request is sufficient for one to be placed on the mailing list.

The following issues are still available in limited quantities from: SMSG – Cedar Hall, Stanford University, Stanford, California 94305.

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Newsletter No. 36 – Final Report on a New Curriculum Project

## REPORTS

This series consists of reports, too long to be included in SMSG Newsletters, on various SMSG projects. Single copies may be obtained by a postcard request to SMSG, Cedar Hall, Stanford University, Stanford, California 94305.

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Two separate editions of the **New Mathematical Library** are now available.

A trade edition is published by Random House, Inc. Each volume in this edition is priced at $1.95. This edition is available in book stores or may be ordered by mail from:

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# NEWSLETTER NO. 40

*October 1972*

New Publications

Overstock Sale

## NEW PUBLICATIONS

Between the issuance of Newsletter No. 37 in March of 1972, and the cessation of SMSG activities at the end of August, 1972, a final set of new publications were printed. Three of these are part of the *Studies in Mathematics* series. The first of these, Volume 20, is designed to provide teachers using the new SMSG sequence, *Secondary School Mathematics*, with a large number and variety of real life applications of the mathematical topics included in that sequence.

The final two volumes in this Series are dedicated to Professor William Brownell. Professor Brownell was a pioneer in advocating the approach to mathematics education which SMSG has used. Professor Brownell's writings are still of great interest to mathematics teachers. These two volumes make available in convenient form a selection, in Volume 21, of his research papers and, in Volume 22, of his theoretical papers.

The remaining new volumes are all in the *NLSMA Reports* series. Report No. 8 discusses and illustrates most of the important statistical programs used in various NLSMA analyses. Reports Nos. 17 and 18 complete the textbook comparison analysis.

Report No. 20 contains a study of student attitudes towards mathematics. Report No. 27 supplements Reports Nos. 21 through 25 by listing, for each mathematics scale administered in NLSMA, those variables which best predicted achievement on that scale.

Report No. 30 reviews the information obtained by means of a questionnaire sent to the Z-Population students a year after they had graduated from high school.

Report No. 31 is an example of how a mathematics education researcher, not on the NLSMA staff, can use NLSMA data to attack his own problem.

Report No. 32 surveys briefly the information on science grades obtained by NLSMA students.

The final report in the series provides, for each population and each year of the study, the intercorrelations of all the mathematical scales administered that year or the year before and the cognitive psychological scales administered during those two years.

## OVERSTOCK SALE

In the case of certain volumes in the *Studies in Mathematics* series, our warehouse stock seems to be considerably in excess of the estimated demand over the next five years. In order to reduce storage and property tax costs, we plan to reduce these stocks to more reasonable quantities.

Before doing so, however, we are offering these volumes, for a limited period, at a reduced price. Each of the following volumes, if ordered before February 1, 1973, can be purchased at one half the normal cost. A special order form appears on page 9.

## STUDIES IN MATHEMATICS

*Volume III, Structure of Elementary Algebra by Vincent H. Haag*

An explantion of the approach to algebra found in the SMSG text "First Course in Algebra" emphasizing the foundations of the subject and the structural properties of elementary algebraic systems.

*Volume IV, Geometry by B. V. Kutuzov*

A translation of a Russian text for teachers. Longer than other volumes in this series (576 pages), it is probably used mostly as a source of supplementary material.

*Volume V, Concepts of Informal Geometry by Richard D. Anderson*

A study of basic ideas, concepts, and points-of-view of geometry, intended primarily for junior high school teachers.

*Volume VII, Intuitive Geometry*

This volume is intended to help elementary teachers develop sufficient subject matter competence in the mathematics of the elementary school program. Both the applications of number in geometry (measurement) and the relationships between geometric elements independent of number are presented to help form a foundation for the later study of geometry.

*Volume VIII, Concepts of Algebra*

This volume provides an understanding of concepts that give elementary school mathematics the very necessary relationship to the total field of mathematics and particularly to subsequent mathematics in the secondary school.

In addition to assistance with terminology the book has numerous exercises with a related answer section to enable the reader to test his understanding.

*Volume X, Applied Mathematics in the High School*

This volume is based on a series of lectures delivered by Professor Max M. Schiffer of Stanford University. These lectures were transcribed and were edited by Professor Leon Bowden of Victoria College, University of British Columbia.

Three chapters are devoted to applications appropriate to the SMSG curriculum with emphasis on the elementary algebra of the ninth grade and the geometry of the 10th grade. An appendix is devoted to applications of matrix algebra.

*Volume XI, Mathematical Methods in Science*

Mathematical Methods in Science is based on a course of lectures delivered by Professor George Polya, Stanford University. These lectures were transcribed and edited also by Professor Leon Bowden.

The course points to the history of certain elementary parts of science as a source of efficient mathematics teaching in the classroom. Simple physical or pre-physical problems are introduced and the relation of mathematics to science and science to mathematics is discussed. Some use is made of elementary calculus.

*Volume XIII, Inservice Course in Mathematics for Primary School Teachers*

The introductory chapter begins with a description of the culturally disadvantaged based on psychological findings. It continues with the physical, social, and psychological environment in which these children function in their pre-school years. The next concern is with the characteristics manifest in the culturally disadvantaged children as they enter school. Finally, implications for teaching these children are discussed in this chapter.

Chapters 1 through 17 present mathematical content relevant to teaching in the primary grades. All topics which are included in the texts for the School Mathematics Study Group Books K and 1 are treated, but from a more sophisticated point of view. Other topics have been included when the development has warranted it.

*Volume XIV, Introduction to Number Systems*

The aim of this book is to help the teacher acquire background for the material which is presented to the junior high school student in the books of the School Mathematics Study Group and other books with similar coverage. We here deal with the development of the system of rational numbers beginning with the properties of the integers as we know them, why they are important, why we make certain definitions in extending the set of integers to the rational numbers and what are their consequences. Hand-in-hand go the graphical representation of numbers and pairs of numbers, for the interplay of geometry and number is important to both branches. Since the idea of equation is also fundamental to the understanding of various connections, we include something of this subject.

*Volume XV, Calculus and Science*

The present material forms part of the series started by Volumes X and XI of the SMSG *Studies in Mathematics* sequences based on the lectures for high school mathematics teachers given by Max M. Schiffer (Applied Mathematics in the High School, Volume X) and by George Polya (Mathematical Methods in Science, Volume XI). In an attempt to provide similar motivation for the audience addressed by Schiffer and by Polya, this volume begins with an introduction suggesting the inclusion of math-science material at the secondary level.

*Volume XVI, Some Uses of Mathematics: A Source Book for Teachers and Students of School Mathematics*

Studies in Mathematics, Volume XVI, contains a collection of articles that is intended precisely to demonstrate the existence of materials on mathematical models and applications that are adaptable to school use and also to help solve the problem of availability.

Several of the articles in the collection deal in a general or philosophical way with the process of building and using so-called mathematical models. Several deal with possible consequences of the impact of computers and of the more widespread exploitation of mathematical methods for practical purposes. Some explain briefly a variety of uses of mathematics in given field. A number work through specific examples in some detail.

*Volume XVII, Mathematical Concepts of Elementary Measurement*

The book has been written with high school mathematics teachers in mind, but it is hoped that some of it will be within the grasp of elementary school teachers, and that it might be usefully read by teachers of science, and by college teachers. The principal concern of the book is to exploit the idea that "measurement involves structure-preserving functions" in order to provide a conceptual framework in which the elementary ideas of measurement can be understood.

## ORDER INFORMATION

1. Accredited schools will be given an educational discount of 30%. Shipping charges will be billed to the purchaser.
2. Other institutions or individuals interested in mathematics education will be given an educational discount of 30% on orders totaling $10 or more. Shipping charges will be billed to the purchaser.
3. Orders totaling less than $10, and not from accredited schools, will be billed at list price, but shipping charges by book post will be paid by A. C. Vroman.
4. Orders from individuals should be accompanied by remittance, including 5% sales tax on orders originating in California.
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8. We believe that it is vital to the success of the individual student as well as to the planned curriculum of the entire class, that Teacher's Commentaries not be sent by us to students. We therefore request that teachers ordering Commentaries for examination please do so on school stationery or in some other way to indicate professional status.
9. As it takes longer to process an order during the rush period in July, August, and September, we urgently suggest that you place your order well in advance of your needs. Orders will be shipped on a first come, first served basis.
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# NEWSLETTER NO. 41

*April 1973*

## Supplement to
## Newsletter No. 37

The following SMSG texts have served their original purpose. There are commercial texts available which are quite satisfactory substitutes. When current stocks of these SMSG texts are exhausted, they will *not* be reprinted:

First Course in Algebra
Geometry
Geometry with Coordinates
Intermediate Mathematics, Part 1
Elementary Functions
Mathematics for Junior High School, Volume 1
Mathematics for Junior High School, Volume 2
Mathematics for the Elementary School, Book 1
Mathematics for the Elementary School, Book 2
Mathematics for the Elementary School, Book 3

All other SMSG Publications listed in SMSG Newsletter No. 37 will continue to be available at the prices listed there.

In addition, the last three volumes in the series *Studies in Mathematics* and the last nine volumes in the series *NLSMA Reports,* all of which appeared after the publication of Newsletter No. 37, are available and are listed on the order blank on the opposite page.

Please consult page 17 of Newsletter No. 37 for Order Information.

# NEW PUBLICATIONS

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| **NLSMA REPORTS** | | | |
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